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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 16 OCTOBER, 1933 NUMBER 10

TRANSMISSIBILITY OF TRACHOMA TO MONKEYS

L. A. JULIANELLE, PH.D.
AND
R. W. HARRISON, PH.D.
SAINT LOUIS

The eyes of monkeys (M. rhesus) can be infected with material obtained by swabbing or grattage from trachomatous human eyes, a follicular conjunctivitis appearing as a specific infection within one to two weeks, which does not involve the cornea. Healing usually leaves no trace. The filterability of the agent was not conclusively disproved. From the Oscar Johnson Institute, Washington University School of Medicine. Conducted under a grant from the Commonwealth Fund of New York.

It would, perhaps, be tautological to indicate the confusion prevalent in the literature regarding the etiological agent of trachoma. With the incitant of the disease either unknown or at best not conclusively established, a number of different opinions have been offered to explain the causation of this disease. It is therefore necessary, in undertaking a study of trachoma, to determine first certain fundamental conditions and this requires a partial repetition of experiments already reported. Consequently, observations have been made on the infectivity of trachoma and its transmissibility to animals, particularly monkeys. This communication comprises a report of these observations.

Experimental

Material for experiments on transmissibility* was obtained either by grattage or swabbing. In the former instance the conjunctival scrapings were collected in 1.5 c.c. sterile salt solution and were ground in a sterile mortar with no further dilution. The ground residue was then injected into animals by subconjunctival inoculation of the upper conjunctiva of one eye after its surface had been pricked in many places. A No. 26-gauge needle was used for both scarification and injection. In the latter instance, material was obtained by rubbing gently the infected human conjunctiva with a dry sterile swab and then repeating the same technic on animals with the same swab.

Since all preliminary experiments to infect smaller animals were uniformly unsuccessful, the study became limited to monkeys and the work to be reported was conducted exclusively on M. rhesus.

1. *Infectivity of whole, conjunctival material.* That the whole conjunctival material from patients with trachoma is infectious for monkeys was established early in the course of this study. It was found that infection is transmitted equally well irrespective of whether the inoculation is made by simple swabbing or by injection, and the resulting infection shows no variations depending upon the manner of transfer. When the transfer is successful the incubation period is found to vary in different animals. If the appearance of follicles be accepted as the first definite sign of infection, then it may be stated that the incubation period varies from 5 days to 3 weeks. In a general way, however, within a few days

* Indebtedness is acknowledged with pleasure to Drs. C. E. Rice and Robert Sory of the U. S. Trachoma Hospitals at Rolla, Missouri, and of Richmond, Kentucky, respectively. Material for this study was made available through their cooperation. The diagnosis of trachoma and the grattages were made by them. To Drs. Lawrence T. Post, of this University, and Rice, appreciation is expressed for examination of animals and for helpful suggestions regarding the clinical condition of the monkeys.

to a week following inoculation, there is a definite thickening of the conjunctiva with mild inflammation and injection of blood vessels. The conjunctiva frequently has a raw-beefsteak appearance, and within 1 to 2 weeks, follicles begin to appear. These increase in number for weeks or months depending upon factors as yet unknown. The first appearance of follicles in the upper lid is usually close to the inner canthus. More follicles are next observed at the external canthus and then there is a gradual progression from both angles towards the central portion of the retrotarsal fold. Eventually the follicles may reach deep into the cul-de-sac, and only on rare occasions, may spread to the tarsus itself. Up to the present time, follicles have never been seen on the bulbar conjunctiva or caruncle.** On rare occasions the follicles which first appear at the inner angle extend gradually and directly to the opposite canthus. In the lower lid, on the other hand, follicles always appear first near the central portion of the cul-de-sac.

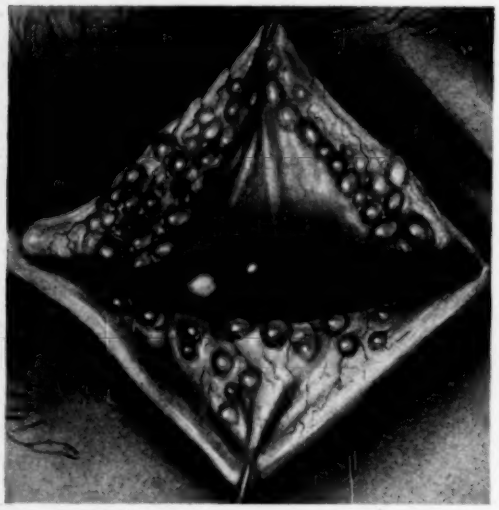

Fig. 1 (Julianelle and Harrison). This eye was infected by direct inoculation with material carried over on a swab from the human eye. The illustration is of the everted lids and was made about 6 weeks following the inoculation.

** Since going to press observations on a single animal show follicles on the bulbar conjunctiva.

At the height of the infection the follicles are characterized by (1) uneven distribution, (2) great variation in size, and (3) marked vascularization which in certain instances is so heavy as to give the follicle a blood-red appearance. These three characteristics will be recognized as the antitheses of those seen in spontaneous folliculosis of man or monkey. It must be pointed out in this connection, however, that in successful transfers, the conjunctiva exhibits invariably only the follicular variety of trachoma, and that the papillary form has never been observed regardless of the type from which the human material inoculated was derived. Moreover, the infection becomes limited to the conjunctiva and the cornea remains free from any detectable reaction.

Of 19 monkeys inoculated in one manner or another, 14 became definitely infected, while the remaining 4 showed no reaction to the inoculation. Fifteen additional monkeys were inoculated on three different occasions with trachomatous material obtained from different sources, following which they exhibited little or no reaction, but upon the fourth inoculation, all fifteen animals became infected, 10 severely and 5 only moderately. This may indicate that the infectivity of a given material depends more upon its potency than upon the degree of resistance possessed by the animal.†

Extension of the infection to the uninoculated eye occurs with considerable regularity. The interval before extension occurs varies in different animals from 1 to 4 weeks. The onset and course of infection differ in no way from that described above in the inoculated eye. It has been impossible to decide, however, whether the extension develops spontaneously or represents manual transfer by the monkey from the infected to the uninfected conjunctiva.

† It was impossible in this study to correlate the infectivity of human material with the presence of trachoma inclusions. Not only did infection occur with material apparently containing no inclusions, but infection was not always transmitted with material rich in inclusions.

The duration of infection was found to vary considerably in different animals. The follicles may disappear within 2 months; on the other hand, they may persist for a year or longer. In any case, there is eventually complete disappearance of follicles, the conjunctiva recovers its normal character, and there is no evidence of a past infection. In only occasional tissues removed for pathological examination, is scar tissue noted in small amounts but it is not clear whether this is the result of the infection or of the manipulation during injection. Up to the present time, no healed conjunctiva has been seen to undergo a reinfection spontaneously.

Several experiments were undertaken to determine whether periodic subconjunctival injections of trachomatous material influence the course of infection in monkeys. Animals were injected once a week from 6 to 8 times, but this method showed no differences in results from those obtained by a single injection. Consequently if trachoma in humans is due to repeated and frequent exposure, it could not be ascertained by experiments in monkeys.

The infection may be transmitted from monkey to monkey. This has been accomplished by transfer with a swab. In this case, the incubation period lengthens, the infection is usually less severe, extension from one eye to the other less frequent, and within 3 to 4 transfers the ability of the diseased tissues to infect is lost. This has been pointed out previously by Bengtson[1]. Experiments are now under way to determine whether transfer by injection, rather than by swabbing, will maintain the potency of the infectious agent.

2. *Specificity of the follicular infection.* Because of the possibility that the follicles which appear subsequent to inoculation might represent an exacerbation of the potential or latent folliculosis which occurs spontaneously in the monkey, experiments were performed to determine the specificity of the infection. While monkeys with frank follicles have been excluded in this study and naturally occuring follicles are readily differentiated from those appearing after inoculation with human material, it nevertheless seemed wise to determine the validity of this possibility. Incidentally an opportunity was afforded to observe the effect of continuous low-grade irritation on the conjunctiva, since it might be reasoned that the follicle, which is essentially a hypertrophy, might originate not so much because of infection as because of irritation, secondarily aggravated by infection.

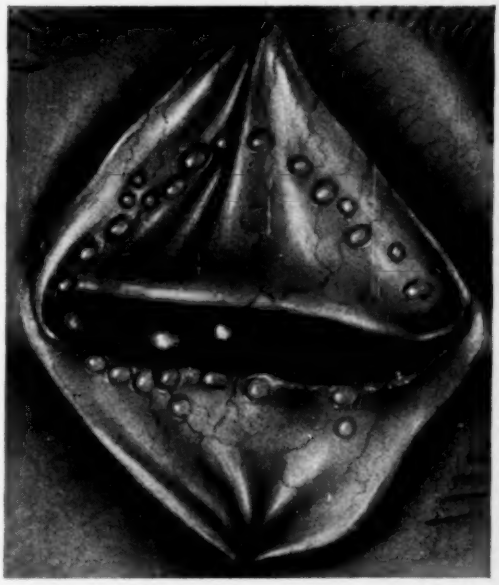

Fig. 2 (Julianelle and Harrison). This represents spontaneous extension of infection from the inoculated eye (figure 1) to the uninoculated eye. Both illustrations were made on the same day.

Accordingly, monkeys with several spontaneous follicles and those with no visible follicles were studied. In some of the animals repeated injections or swabbings were made of a variety of bacteria isolated from the eye in trachoma but not including B. granulosis. The organisms were injected as pure strains and as cultures pooled in different mixtures. None of the bacteria employed, either singly or collectively, was capable of inducing the formation of follicles.

In a similar group of animals, the conjunctiva was first irritated over a period of time, either mechanically by

scarification or by sensitization to bacterial proteins. In the latter instance, this was accomplished by 6 to 8 subconjunctival injections of the bacterial protein performed once a week. At this time, each injection of the protein caused a definite Arthus reaction of moderate severity in the conjunctiva. In either case, the irritated conjunctiva was later instilled with bacterial cultures. In no instance was there ever an extension of the follicles already existing, or the formation of follicles *de novo*.

That the follicle formation following transfer of trachomatous material to monkeys is due to a specific infection gains further support from the results of experiments devised to determine the transmissibility of spontaneous, human folliculosis. Material from the conjunctiva in this instance was obtained in the same manner as was described in the case of trachoma, and inoculations were performed in the same way. To date, material has been obtained from eight patients with folliculosis and transfers have been made to 12 monkeys. In none of the animals was folliculosis transmitted. While it is desirable to repeat this experiment with more material, the indications are, nevertheless, that material from spontaneous human folliculosis is not infectious for monkeys and does not induce the formation of follicles in the conjunctiva of monkeys.

Table 1

INFECTIVITY OF FILTERED HUMAN TRACHOMATOUS MATERIAL FOR MONKEYS

Results of Injections in			Culture of filtrate
Monkeys		Rabbits	
Filtered material	Unfiltered material	Filtered material	
3 injected all negative	none injected	2 rabbits both negative	no growth
4 injected all negative	none injected	2 rabbits both negative	no growth
2 injected both negative	2 injected 2 infected	2 rabbits both negative	no growth
4 injected all negative	4 injected 4 infected	3 rabbits all negative	no growth
2 injected both negative	none injected	2 rabbits both negative	no growth
4 injected all negative	4 injected 4 infected	none injected	no growth
2 injected both negative	none injected	none injected	no growth
6 injected 3 infected	4 injected 4 infected	none injected	no growth
2 injected both negative	2 injected both negative	none injected	no growth

When the experiments on specificity of the follicular infection in monkeys were concluded, some of the animals were subsequently inoculated with whole trachomatous material to determine whether they were naturally resistant to experimental trachoma. Sufficient successful transfers were obtained to justify the conclusion that the appearance of follicles in monkeys following inoculation of human trachomatous material is a specific response de-

pendent upon the infectivity of the material.

3. *Filterability of the infectious agent present in trachomatous material.* When it had been established that whole material from human trachoma contained a definite and specific agent infectious for monkeys, experiments were undertaken to determine the filterability of the organism. The following technic was adopted for filtration: Material from several patients was pooled and ground in a sterile mortar. Sufficient ground material was reserved for injection to determine original infectivity. The remainder was run through a Berkefeld V filter, No. 11, after the following preparations had been made: In order to eliminate surface and therefore to conserve material, the filter was coated with a rubber finger stall leaving about one-half inch of the filter exposed. Sufficient melted paraffin was poured into the bottom of the glass jacket to cover the metal collar of the filter and allowed to harden. One c.c. of salt solution was later run through the filter. The ground grattage material was then filtered. This required in general about 5 to 10 minutes at a pressure of 10 to 15 inches of water. A number of variations were tried, but eventually preference was given to the technic outlined.

The sterility of the filtrates was determined by cultures in semisolid-leptospira medium and on horse-blood agar plates.

The infectivity of the filtrates was tested by (1) subconjunctival injection, conjunctival swabbing, and conjunctival instillation following scarification in monkeys; (2) intratesticular and intracutaneous injections and pericorneal inoculation after multiple scarification in rabbits. While all these inoculations together with testing of the unfiltered material were carried out in some of the experiments, it was not possible, because of the small quantities of material, to do as described in all the experiments.

To date, 9 different experiments, including 29 monkeys, have been done. In 5 of these, the unfiltered material was tested, while in 4 it was not. In 5 of the experiments, the infectivity of the filtrates was also tested in rabbits as described above. An analysis of the data as presented in the table reveals: (1) in the 5 experiments in which the infectivity of the unfiltered material was tested, it was definitely infectious in 4 and noninfectious in 1; (2) in the 5 experiments in which the infectivity of the filtrates was tested in rabbits, there was no reaction following inoculations as described; of the 9 experiments with 29 monkeys, in 8 experiments including 23 animals, the filtrate was found to be noninfectious, while in 1 experiment comprising 6 monkeys, 3 presented follicles following inoculation of filtrate, and 3 gave no visible response. In the latter experiment, the unfiltered material was of unusual potency, infecting heavily all 4 control animals, but the filtrate when cultured showed no bacterial growth. It is unfortunate that no rabbits were tested with filtrate in this experiment.

Two experiments were conducted to test the infectivity of the material following fractional centrifugation. On neither occasion was any evidence obtained to show that the supernatant fluid of the centrifugalized material contained the infectious agent.

It should be added that a sufficient number of the monkeys that gave no response to the filtrates was subsequently inoculated with whole unfiltered material from other patients to eliminate the possibility of a high-grade natural resistance, and infection was induced in the usual proportion.

Discussion

That trachoma may be transmitted from man to apes and monkeys has been demonstrated by a number of observers[2]. This study has confirmed their results. It has been shown that material, obtained by grattage or swabbing of human trachomatous conjunctiva, contains an agent capable of infecting the conjunctiva of M. rhesus. The infection is manifested by the appearance of follicles which are transient, disappearing in time and leaving no permanent changes in the lid. The cornea, moreover, does not participate

in the reaction. Despite these differences from human trachoma it is nevertheless believed that the infection is the counterpart of the human disease. The reasons leading to this conclusion are (1) the clinical similarity of the lesions to trachomatous follicles, (2) the clinical dissimilarity to spontaneous folliculosis, and (3) the specificity of the infection as described in the foregoing experiments. Experience in the study of other diseases also illustrates the general difficulty in reproducing in experimental animals the exact picture of human infections.

Except for that advanced by Nicolle, Cuénod and Blaizot[3], Bertarelli and Cechetto[4], and by Cattaneo[5], the evidence[6–10] is that the infectious agent of trachoma is not a filterable virus. Olitsky, Knutti, and Tyler[11] have shown recently that one of 20 monkeys inoculated with filtrates of human or monkey material developed experimental trachoma, while 9 of 16 animals inoculated with unfiltered material showed characteristic infection. Similarly the results reported in the present communication indicate that in general, the infectious agent of trachoma does not pass through bacteriological filters. Thus of 29 animals inoculated with filtered material only 3 developed follicles while of 16 monkeys inoculated in parallel experiments with unfiltered material 14 became definitely infected. Further study is necessary to determine the significance of the positive results obtained with filtered material.

Summary and Conclusions

1. Material obtained from human trachoma by grattage or swabbing contains an agent capable of infecting the conjunctiva of monkeys (M. rhesus).

2. The infection in monkeys appears in general after an incubation period of 1 to 2 weeks.

3. The infection becomes manifest as a follicular conjunctivitis, never as a papillary conjunctivitis.

4. The follicles are distributed unevenly, they vary in size, and are heavily vascularized.

5. The follicles eventually disappear leaving little if any trace of the recent infection in the conjunctiva.

6. The cornea remains normal throughout the infection.

7. Evidence is presented to show that the infection is specific of trachomatous material.

8. Evidence on the filterability of the infectious agent is not conclusive, but the probabilities are that the agent is, as a general rule, not filterable.

640 S. Kingshighway.

References

[1] Bengtson, I. P. Science, 1933, v. 77, p. 1991.
[2] Weiss, C. Studies on trachoma. Jour. Immunol., 1933, v. 25, no. 9, pp. 227-273.
[3] Nicolle, C., Cuénod, A., and Blaizot, L. Arch. d. l'Inst. Past. Tunis, 1913, v. 3-4, p. 157.
[4] Bertarelli, E., and Cechetto, E. Centralbl. f. Bakt., 1908, pt. I, (Orig.), v. 47, p. 432.
[5] Cattaneo, D. Rev. Internat. de Trach., 1932, v. 9, p. 186.
[6] Hess, C., and Römer, P. Arch. f. Augenh., 1906, v. 55, p. 1.
[7] Bajardi, P. Clin. Ocul., 1907, v. 8, p. 2719.
[8] Fermi, C., and Repetto, R. Berl. klin. Wchnschr., 1907, v. 44, p. 1197.
[9] Szafnicki, M. Zentralbl. f. d. ges. Ophth., 1929, v. 21, p. 46.
[10] Trapesontzewa, C. Rev. Internat. de Trach., 1930, v. 7, p. 65.
[11] Olitsky, P. K., Knutti, R. E., and Tyler, J. R. Jour. Exp. Med., 1931, v. 54, p. 557.

CHEMISTRY OF THE LENS*

C. S. O'Brien, M.D., and P. W. Salit, Ph.D.
IOWA CITY

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The chemistry of the crystalline lens is, at the present time, the subject of much active investigation. It is by such researches that we hope to throw light upon the etiology and mechanism of senile cataract. A great many facts are known, but much remains to be done before our conception of the chemistry of the normal and pathologic lens is complete.

Weight

It is established, beyond any doubt, that the crystalline lens gradually increases in weight throughout life; Jess believes the increase is related only to age, and not to the relative size of animals of the same kind. In senile cataract there is a progressive loss of weight, from the stage of incipiency, through other stages, to that of hypermaturity.

In 1913 Jess published the results of an investigation into the weights of 100 normal lenses removed from 50 oxen. The lens weight shows a gradual increase throughout life, from a minimum of 0.8956-0.9870 gm. in calves 3 weeks of age, to a maximum of 2.5477-2.8322 gm. in 16-year-old cattle. From these figures it is apparent that there is an approximate increase in weight of 50 percent. According to Jess, Heine found that the lens increases in weight from a minimum of 0.157 to a maximum of 0.244 gm., an increase of 55 percent; E. V. Jäger's figures were from 0.163 to 0.279 gm. in the eighth decade, an increase of 71 percent. Jess found, as had Römer and Freytag, that the weight of the two lenses in the same animal varies within narrow limits. Similar findings were recorded recently by one of us (P.W.S.), while working in the laboratories at the University of Iowa. According to Salit normal beef lenses increase from an average minimum weight of 0.9846 gm. in 5-week-old

* From the Department of Ophthalmology, College of Medicine, State University of Iowa. Read before the Association for Research in Ophthalmology, in Milwaukee, June 13, 1933.

calves, to a maximum weight of 1.960 gm. in 1½- to 2-year-old cattle. Priestley Smith, in 1882, published the results of a study of 156 transparent human lenses, removed from 91 persons immediately after death. The following table is taken from his article:

No. of lenses	*Age*	*Aver. wt. in gm.*
21	20-29	0.174
22	30-39	0.192
23	40-49	0.204
21	50-59	0.221
23	60-69	0.240
12	70-79	0.245
6	80-90	0.266

The extremes of weight were 0.151 and 0.283 gm.; average 0.237 gm. In this series of cases there was an average increase in lens weight of 1.5 mg. during each year between the ages of 20 and 70 years. W. J. Collins, in 1889, found the weight of 6 clear human lenses, in patients from 10 to 64 years of age, to vary from a minimum of 0.163 gm. to a maximum of 0.247 gm., an average of 0.204 gm. Burdon-Cooper states that, according to Sir William Collins, the lens at birth weighs approximately 0.120 gm., at age 10 it weighs 0.160 gm., at 25 the weight is 0.220 gm., at age 65 there is an increase to 0.250 gm., and at 80 years of age the lens weighs 0.260 gm. Clapp, in 1924, published a report giving the average weight of the infant lens as less than 0.0953 gm.; he quotes Becker's statement that the weight of the newborn lens is 0.1 gm., and of the adult lens 0.218 gm. In an analysis of 24 normal human lenses, in persons from 23 to 66 years of age, Adams found a minimum weight of 0.0904 and a maximum of 0.2176 gm.—an average weight of 0.1348 gm. Updegraff gives the average weight of 46 human lenses, apparently including both normal and cataractous types, as 0.2237 gm. (minimum weight 0.1046 and maximum 0.3606 gm.). Clausnizer, on the basis of his own and Grunert's data, gives the average weight of 12 dislocated clear lenses as 0.227 gm.

The dry weight of the normal lens, i.e., the weight after artificially drying to a constant level, was found by Burge to be 0.0155 gm. for the embryo, and 0.0590 gm. for adults. Adams found the minimum dry weight to be 0.0292 and the maximum 0.0736 gm., an average of 0.0530 gm. Mackay, Stewart, and Robertson give the average dry weight of 18 normal lenses as 0.0601 gm. Salit found the dry weight of 61 beef lenses to vary from a minimum of 0.3073 gm. in a calf 5 weeks old, to a maximum of 0.8697 gm. in an animal 2 years of age.

Most investigators have found that the cataractous lens is lighter in weight than the normal lens of the same age. Priestley Smith made such an observation many years ago. Collins gives the minimum weight of 10 cataractous lenses as 0.0850, and the maximum as 0.1363 gm., an average of 0.113 gm.; i.e., approximately one half the average weight of 6 clear lenses. In 1911 Clausnizer, from his own and Grunert's data, fixed the average weight of 30 immature cataracts at 0.236 gm., and of 36 mature cataracts at 0.213 gm.; in 19 dislocated opaque lenses the average weight was 0.183 gm. Balling found the weight of human cataractous lenses to vary between 0.0761 and 0.2567 gm. Clapp gives the average weight of 19 cataractous lenses, in patients whose average age was 66 years, as 0.1640 gm. —it is evident that this weight is too low, since the lenses were removed by both the extra- and intracapsular methods. Maynard states that the average weight of the European cataractous lens, according to Priestley Smith, is 0.224 gm. (minimum 0.171 and maximum 0.277 gm.); his own figure for 11 Indian cataracts is lower; i.e., 0.219 gm. (minimum 0.168 and maximum 0.286 gm.). Maynard's opinion is that cataracts in natives of India are, on an average, lower in weight than in Europeans; it may be that this is due to the early age at which cataract appears in India; i.e., the patients are comparatively young, consequently the lens has not reached the weight that it has in older Europeans. Maynard, contrary to most opinions, believes that Indian cataract increases in weight as it ripens and passes into the stage of hypermaturity. Kubik states that the cataractous lens increases in weight with advancing age, and that the body weight influences the weight of the lens; he believes, how-

ever, that, in general, the weight of the cataractous lens is less than that of the clear lens. Kubik found the average weight of 29 incipient cataractous lenses to be 0.206 gm., of 138 almost mature cataracts 0.209 gm., of 58 mature cataracts 0.188 gm., and of 18 hypermature cataracts 0.174 gm. Mackay *et al* give the average dry weight of 27 cataractous lenses as 0.0441 gm., as against 0.0601 gm. for 18 normal lenses. Adams found that the weight of 31 cataractous lenses, in patients between the ages of 50 and 77 years, varies between a minimum of 0.0680 and a maximum of 0.1284 gm., an average of 0.0987 gm.; the average dry weight is 0.0445 gm. Salit recently weighed 103 cataractous lenses, all of which were removed intracapsularly, and found the average weight of an incipient cataract to be 0.2026 gm., of mature cataract 0.1989 gm., and of the hypermature variety 0.1890 gm. In his opinion, contrary to the beliefs of Maynard and Kubik, the weight of the lens decreases slowly in the incipient stage of cataract, and rapidly in the stage of maturity.

Volume

There is an increase in volume of the lens with advancing age. In senile cataract there is a decrease in volume. Becker, in the Gräefe-Saemisch Handbuch states, "In the newborn child the lens is smaller than in the adult." Burdon-Cooper quotes Becker as authority for the statement that the volume is 155 c.mm. at 20 years of age, 195 c.mm. at 50, and 217 c.mm. at age 60. Priestley Smith observed that the cataractous lens is smaller than the clear lens of a similar age; he gives the volume of 156 normal lenses as follows:

No. of lenses	*Age*	*Aver. vol. in c.mm.*
21	20-29	163
22	30-39	177
23	40-49	188
21	50-59	205
23	60-69	225
12	70-79	227
6	80-90	244

The average volume of the clear lens is 220.4 c.mm. (minimum 139 and maximum 262 c.mm.), and of the cataractous lens 208.0 c.mm. According to the above table the volume increases on an average of 1.5 c.mm. per year, from ages 20 to 70.

Herbert in his book entitled "Cataract extraction" gives the average volume of 15 cataractous lenses removed in India as 225.6 c.mm. (minimum 153, and maximum 296 c.mm.). Maynard found an average value of 237 c.mm. (minimum 162, and maximum 305 c.mm.).

Ash

The ash of the lens, which naturally is composed entirely of inorganic material, is comparatively small in amount. Collins, in 1889, found the average ash in 6 clear lenses to be 0.6 percent, and in 10 cataractous lenses 1.57 percent of the dry weight of the lens. Goldschmidt, according to Jess, found 2.62 to 3.16 percent ash. Michel and Wagner quote Kühne's figures on the ash as 0.5 percent, Hoppe-Seyler's on dry ox and sheep lenses as 0.73 percent (0.12 percent insoluble ash, and 0.61 percent soluble ash), and Laptschinsky's on dry ox lenses as 0.67 percent (0.17 percent insoluble, and 0.50 percent soluble). Burge, working on a large number of lenses, found the following values:

Type of lens	*Wt. of ash (mg.)*	*Percentage of ash to dry wt. of lens*
Embryo human	0.25	1.60
Normal adult	1.40	2.30
Cataract (U.S.A.) ...	0.58	1.68
Cataract (India)	1.52	1.64

Maynard states that the absolute average ash in Indian cataract is 1.95 mg. (minimum 0.6, and maximum 7.99 mg.); he thinks that in India the ash is unusually small and variable. Hijikata found the average ash in ox eyes to be 0.76 percent.

Water Content

It is believed by most investigators that the water content of the lens gradually decreases with age; there is a further decrease in senile cataract.

Michel and Wagner quote Berzelius as having found the water content of the ox and pig lens to be 58 percent, Simon found 65.76 percent for the ox, and 60 percent for the horse, Brandes 75 percent for the horse, Schneyder

63.27 percent in a 5-year-old boy, and Kühne found the water content to be 60 percent. W. J. Collins believes that the water content of the normal lens remains constant, but that it is lower in the cataractous lens; he gives the average water content of the clear lens as 70 percent, whereas the cataractous lens is only 62 percent water. He quotes Laptschinsky's figure of 63.5 percent (oxen), Jacobson's 70.8 percent, and Wecker and Landolt's figure of 60 percent. Deutschmann, according to Jess, reported a relative decrease in water content with advancing age. Jess found that in ox eyes the water content decreases from 67.5 percent to 61.5 percent with advancing age. The absolute water content decreases in senile cataract; the decrease in water exceeds the decrease in protein, resulting in a proportion of 58.39 percent water and 41.11 percent protein. Hijikata reported the water content of the ox lens as 64.30 percent. Clapp quotes Neumeister's figure of 63.50 percent. Bürger and Schlomka found that the water content of cattle lenses decreases from 68.5 percent in the first year of life to 63.4 percent in the twentieth year. Evans and Kern state that cataractous lenses, from thyroparathyroidectomized dogs, have a water content of 64 percent, whereas the normal dog lens contains 61 percent water. Salit found the water content in 45 cattle lenses to decrease on an average from 68.6 percent in 5-week-old calves, to 64.6 percent in 2-year-old cattle. Cahane estimated the water content of beef lenses on the basis of age, finding an average of 60.47 percent in calves up to 5 months of age, and 59.47 percent in animals 3 to 5 years of age. His figures on 5 human lenses are as follows: clear lens, age 14—66.57 percent; cataract, age 48—71 percent; clear lens, age 60—65.91 percent; clear lens, age 70—61.95 percent; and cataract, age 75—67.31 percent. He states that experiments on the lenses of calves, oxen, dogs, and man show that the water content gradually decreases with age.

Solids

One may estimate the solids which are made up of protein, inorganic constituents, and small amounts of urea, sugar and amino acids, from the values given in the above paragraph—the remaining percentage, after the removal of water, being solids. Clapp estimated the average solids in 19 cataractous lenses as 0.0451 gm. or 27.02 percent. He states that Priestley Smith and Treacher Collins place the percentage of solids in adults at 29.0 percent, and Neumeister at 36.50 percent. Salit estimates the average solids in 25 2-year-old cattle lenses at 35.39 percent.

Inorganic Constituents

The normal lens contains many inorganic or mineral constituents—sodium, potassium, calcium, sulphates, phosphates, and chlorides in larger amounts, and magnesium, lithium, etc., in lesser quantities. Electrolytes are present in the lens as well as in the aqueous and vitreous. The positive ions of these electrolytes have a greater affinity for protein, as shown by comparative studies of the blood and aqueous, consequently a certain percentage of these ions are held in combination with the protein, whereas the negative ions are not held in such combination and migrate more freely. On this basis one expects the sodium-chloride ratio to be greater in the lens than in the aqueous or vitreous. In cataract the calcium, sodium, chlorides, and sulphates increase, especially calcium; potassium and the phosphates decrease.

Michel and Wagner state that Berzelius found 1.3 percent of aqueous salt extractives, and 2.4 percent of alcohol salt extractives; Simon found the sodium chloride extractives in the ox to be 0.495 gm., and in the horse to be 0.426 gm.; Schneyder, working with the lens of a 5-month-old child, found 2.31 percent salts; and Cahn found, in the normal lens, 1.36 percent average soluble salts, and 0.46 percent insoluble salts; in the cataractous lens the soluble salts vary from 1.81 to 2.41 percent, and the insoluble salts from 1.14 to 1.45 percent. The following table, from Burdon-Cooper's spectroscopic analysis of normal pig and ox lenses, gives an idea of the many minerals found in the lens:

	Pig lens	*Ox lens*	
Mineral	(a) and (b)	(a)	(b)
Lithium	Absent	Trace	Absent
Sodium	Dominant	Dominant	Dominant
Potassium	Little	Much	Much
Magnesium	Little	Little	Little
Calcium	Little	Little	Little
Strontium	Absent	Absent	Absent
Zinc	Absent	Trace	Trace
Lead	Trace	Absent	Absent
Silver	Absent	Absent	Absent
Iron	Absent	Absent	Absent
Silicon	Absent	Trace	Absent
Boron	Trace	Absent	Absent
Phosphorus	Little	Little	Little

Calcium. Of all the inorganic substances in the lens, calcium has received the most attention, since it is thought by some to have a bearing on cataract formation; by others its increase in the cataractous lens is looked upon as the end result of denaturation of protein. Burge found practically no calcium in the normal lens, but an average of 12.5 percent of ash in cataractous lenses from Americans, and 6 percent in similar lenses from India; he believes there is increased calcium and diminished potassium in the cataractous lens. Levina states that rats, fed on a diet deficient in vitamin A, developed partial cataracts; she considers the lens opacities to be the result of a disturbance in calcium metabolism, with accumulation of this element in the lens. Kranz found deposits of calcium carbonate in the nucleus of many clear and cataractous lenses. Bürger and Schlomka found the ash from 17 gm. of wet normal lens substance to contain only a trace of calcium; they believe the calcium content does not change with age. Burdon-Cooper reported the normal lens of the pig and ox to contain "little" calcium, when examined spectroscopically; human cataractous lenses vary in calcium content from "little" to "much." Boente agrees with Wessely who pointed out that gravellike accumulations of calcium phosphate are frequently present in the lens. Salit was unable to find calcium in the normal lens of cattle or rabbits but in 44 human cataracts, removed by both the extra- and intracapsular methods, the average calcium content was 35.4 mg. percent (minimum 2.8 and maximum 104 mg. percent). He was unable to find any parallel between the amount of calcium and the age of the patient. Goldschmidt, according to Woods, states that calcium increases 15 percent with advancing age. In thyroparathyroidectomized dogs with cataract, Evans and Kern found that the calcium of the ashed lens amounts to 28.7 percent; i.e., twenty-five times normal. Kirby states that the increased calcium in the cataractous lens does not necessarily mean that calcium produces cataract, it may be secondary. He thinks that if calcium is the cause of cataract, it may effect this by decreasing the permeability of the capsule, by sensitizing the protein to ultraviolet light, or by direct injury to the lens protein; if the calcium deposits are secondary the accumulation is due to the affinity of calcium for phosphates and fatty acids. Boente studied 11 cases of cataracta brunescens in which slitlamp study showed spherolithic crystals in the nucleus; these crystals proved to be calcium phosphate, in all except one case, in which they were composed of calcium carbonate. Updegraff found the calcium to vary from 8.9 to 17.6 mg. percent in 8 normal lenses; in 5 immature cataractous lenses the amount of calcium was small, but in 44 mature cataracts it ranged from 0 to 14,072 mg. percent, the latter figure being from a calcified dislocated lens. Mackay *et al* state that Burdon-Cooper and Lewis believe there is a diminishing K/Ca ratio with the development of cataract. Mackay records the following findings: in 16 normal human lenses the calcium averages 0.029 percent of dry lens substance, in 4 immature cataracts 0.084 percent, and in 16 mature senile cataracts 0.201 percent; the percentages of ash were 1.01, 2.31, and 5.49, respectively. Recently Salit published the figures on the calcium content of 103 cataractous lenses removed by the intracapsular method. Based on a slitlamp diagnosis of the stage of maturity the average calcium content is as follows: incipient cataract, 5.8 mg. percent; intumescent stage 30.5 mg. percent; and mature cataract 50.9 mg. percent. Of the 35 incipient cataracts 15 contain no calcium, 16 vary between 2 and 6.7 mg. percent, and the remaining 4 lenses con-

tain up to 56.7 mg. percent. Of the 40 in the intumescent stage 2 contain no calcium, 3 less than 10 mg. percent, and the remainder up to 80.2 mg. percent. In the series of 28 mature cataracts the lowest figure is 31 mg. percent and the highest 150.6 mg. percent.

Sodium. Burge found no sodium in either the normal embryo or adult human lens, but did find it in the normal pig lens. That the sodium content increases with cataract formation is evident from his findings; i.e., 23.82 percent in the ash of cataracts from Americans, and 25.06 percent in similar lenses from India. Burdon-Cooper, by spectroscopic examination, found sodium in the normal pig and ox lens, and also in "dominant" quantities in the human cataractous lens. In thyroperathyroidectomized dogs with cataract Evans and Kern believe the sodium remains unchanged. The amount of sodium, according to Mackay *et al*, is as follows: in 16 normal human lenses, an average of 0.385 percent of dry lens substance, and 12.6 percent of ash; in 4 immature senile cataracts, an average of 0.603 percent of dry lens, and 16.5 percent of ash; and in 16 mature senile cataracts, an average of 0.622 percent of dry lens, and 27.3 percent of ash.

Potassium. Burge found a decrease in potassium from 38.80 percent of the ash in the normal lens, to 9.80 percent in the cataractous lens; Indian cataracts contain even less potassium—5.81 percent. Burdon-Cooper, by spectroscopic examination, found "small" amounts of potassium in the normal pig lens, and larger amounts in ox lenses; in human cataractous lenses there is from a "trace" to "little." Potassium is decreased from 29.5 percent of the ash in normal dogs to 21.8 percent in thyroparathyroidectomized animals, according to Evans and Kern. Mackay *et al*, estimating the potassium in percentage of dry lens, found an average of 0.635 percent in 16 normal human lenses, 0.309 percent in 4 immature senile cataracts, and 0.092 percent in 16 mature senile cataracts; the percentages of ash are 21.8, 8.45, and 2.4, respectively.

Sulphates. Sulphates are present in the lens, according to analyses made by Mackay *et al*; in normal human lenses there is an average of 1.20 percent of the dry lens, and 45.8 percent of ash; in 16 mature cataractous lenses, 1.66 percent and 48.1 percent, respectively.

Phosphates. Woods quotes Goldschmidt as having found that the phosphorus salts increased 20 percent with advancing years. Evans and Kern state that the phosphates in the lenses of thyroparathyroidectomized dogs are slightly decreased. Burdon-Cooper found "little" phosphorus in normal animal lenses, but "traces" in the cataractous human lenses. Updegraff found phosphorus in amounts between 3.9-5,162 mg. percent in 39 lenses; as a rule the values fell between 10 and 30 mg. percent. Mackay *et al* give the following values for phosphates: an average in 16 normal human lenses of 0.537 percent of dry lens substance, and 18.6 percent of ash; in 4 immature senile cataracts an average of 0.303 percent of dry lens, and 8.3 percent of ash; and in 16 mature cataractous lenses 0.386 percent of dry lens, and 11.1 percent of ash.

Chlorides. O'Brien and Salit found the sodium chloride content of 2-year-old cattle lenses to range between 173 and 386 mg. percent. Mackay *et al* give the following values in their publication: in 16 normal human lenses an average of 0.097 percent of dry lens substance, and 3.4 percent of ash; in 4 immature senile cataracts 0.272 percent of dry lens, and 7.4 percent of ash; and in 16 mature senile cataracts an average of 0.325 percent of dry lens, and 8.5 percent of ash.

Magnesium. Burge states that it is questionable whether magnesium occurs in the normal human lens, but in cataracts from residents of the U.S.A. there is an average of 8 percent in the ash; much less (1.6 percent) is present in cataracts from India. Burdon-Cooper, with the spectroscope, could discover but "little" magnesium in normal animal lenses, however "considerable" may occur in human cataractous lenses. In the lens of the thyroparathyroidectomized dog, Evans and Kern found the magnesium to be increased.

Silicon. Burge could find silicon only in cataractous lenses from India; here

the value is 3.63 percent of the ash. Spectroscopically Burdon-Cooper found a "trace" in some normal animal lenses, also in some human cataracts.

Iron. Burdon-Cooper was unable, as a rule, with the spectroscope, to find iron in either normal or cataractous lenses. Corrado could find no iron in his case of black cataract. Carmi examined 4 black cataracts for iron and states that traces are present, but no more than in other types of cataract.

Other minerals. According to Burdon-Cooper, spectroscopic examination of normal pig and ox lenses sometimes reveals "traces" of lithium, zinc, lead, and boron; human cataractous lenses may contain small quantities of strontium, lithium, zinc, lead, silver, and boron. Zinc is present in almost every lens. He thinks that strontium occurs regularly in nature and is of no especial interest; it is doubtful if silver is ever a normal constituent of the lens.

Organic Constituents

Nitrogen. Nitrogen is present in the normal lens chiefly in the form of protein, there being approximately 16 to 17 percent in this form. In addition there is a small amount of nonprotein nitrogen, approximately 0.1 percent; this probably is in the form of free amino acids, urea, and ammonia. There is a gradual increase in nitrogen content with advancing age, as a result of and parallel with the increase in protein. On the other hand nitrogen decreases with cataract, along with a decrease in protein content.

The nitrogen content, as found by Mörner in 1894, is as follows: alpha crystallin 16.68 percent, beta crystallin 17.04 percent, and albuminoid 16.62 percent. In 1921 Jess published similar results: alpha crystallin 16.40 percent, beta crystallin 17.00 percent and albuminoid 16.34 percent. Bürger and Schlomka, working with normal cattle lenses, estimate that the nitrogen content, on the basis of the fresh lens, increases from 5.04 percent in the first year to 5.89 percent in the 20th year. Nitrogen, based on dry weight of the lens, increases from 16 percent in animals one year old, to 16.5 percent during the first 10 years; it then decreases during the next 10 years to 16.1 percent. Salit found an increase in nitrogen content of normal cattle lenses, from an average of 4.14 percent of the wet weight in calves two months of age, to 5.79 percent in two-year-old animals. The nonprotein nitrogen remains approximately the same for all ages; i.e., an average of 0.1 percent. The protein content (parallel with total nitrogen) increases on an average from 25.86 percent in calves 2 months of age, to 35.71 percent in 2-year-old cattle. In 17 human cataractous lenses, removed by both the extra- and intracapsular methods, the total nitrogen varies between 5.86 percent in the incipient stage, and 2.11 percent in mature cataract.

Protein. The lens protein, on an average, is made up of approximately equal parts of soluble and insoluble fractions. In early life there is a predominance of soluble proteins, but in advanced age the insoluble element is greater. In the soluble fraction there are about 1 part alpha crystallin, 2 parts beta crystallin, and an exceedingly small amount of albumin, whereas the insoluble fraction consists of albuminoid. In senile cataract there is a decrease in the total protein content, chiefly as a result of loss of the soluble fraction.

Michel and Wagner give the following findings of early workers in lens protein: Berzelius (1830) who gave the name "crystallin" to lens protein, found the coagulable albuminous material of the ox and pig lens to be 35.9 percent; Simon found that the ox lens contains 23.290 percent "albumin" and 10.480 percent "crystallin" (total protein 33.770 percent), and the horse lens 23.531 percent "albumin" and 14.200 percent "crystallin" (total protein 37.731 percent). Mulder determined the make up of protein as carbon 55.39 percent, hydrogen 6.94 percent, nitrogen 16.51 percent, and oxygen 21.16 percent; Rüling obtained almost similar results —carbon 54.2 percent, hydrogen 7.1 percent; nitrogen and oxygen 37.5 percent, and sulphur 1.2 percent; Schneyder, in a 5-month-old boy, found the lens contains, "crystallin" 21.002 percent, "albumin" 1.568 percent, and coagulable

protein (coagulable with HCl at 100°C) 3.180 percent; Kühne found the soluble protein to be 35.0 percent, and the insoluble 2.5 percent; Hoppe-Seyler, working with dry ox and sheep lenses, found 33.03 percent albuminous material. Over fifty years ago Laptschinsky analyzed the protein content of normal ox and cataractous human lenses; he found the average figure to be 34.93 percent, evidently based on fresh material. Cahn, presumably basing his figures on dry lens substance, found that the normal ox lens consists of approximately 94.71 percent protein, whereas human cataractous lenses have a protein content of from 81.48 to 85.37 percent. Michel and Wagner found no protein in the nucleus of mature senile cataractous lenses, and only traces of globulin in the cortex.

Mörner analyzed the protein quantitatively with the following results: soluble fraction 52 percent (alpha crystallin 19.5 percent, beta crystallin 32 percent, and albumin 0.5 percent); insoluble fraction 48 percent (albuminoid). He states that the amount of insoluble protein is increased in the senile lens. The transformation of soluble protein to the insoluble variety, shown by a decrease in the former and an increase in the latter in senile cataract, may have an etiologic bearing on this condition. Jess found 32 percent protein in young lenses and 38 percent in aged persons. The total percentage of protein increases with age in the normal lens, with the albuminoid content exceeding that of the crystallins, whereas in youth the crystallins prevail. The proportion of crystallins to albuminoid changes from 82 percent crystallins and 18 percent albuminoid in youth, to 41 percent crystallins and 59 percent albuminoid in age, or in percentage of lens weight from 25.46 percent crystallins and 5.6 percent albuminoid, to 14.88 percent crystallins and 21.47 percent albuminoid. Jess agrees with Mörner regarding the senile lens; i.e., there is a decrease in soluble proteins, especially beta crystallin, and an increase in the insoluble fraction. Schanz believes the soluble proteins of the lens, when acted upon by light, become less soluble and thus sclerosis is produced. Hektoen and Schulhof state that the outer layers of the lens cortex contain more alpha and the inner layers more beta crystallin; the absolute amount of both crystallins is reduced in cataractous lenses. Clapp gives Neumeister's findings as "albumin" 35 percent (insoluble albuminoids 17 percent, beta crystallin 11 percent, alpha crystallin 6.8 percent, and albumin 0.2 percent). Adams states that a decrease in the protein content of old lenses was noted by Cahn in 1884 and by Wagner in 1886. Salit found the proteins to increase from 25.86 percent in 2-month-old calves, to 35.71 percent in 2-year-old cattle. The protein in 17 human cataractous lenses is approximately normal in the incipient stage but it is low in late maturity. Tsuji found that in animal cataracts, produced by massage or naphthalene feeding, there is a decrease in lens protein with a disappearance of beta crystallin. He thinks there is an increase in alpha crystallin. Calcium precipitates alpha crystallin, but sodium and potassium do not; this action of calcium is counteracted by sodium, potassium, and beta crystallin —hence Tsuji explains cataract by a decrease in potassium and beta crystallin and an increase in alpha crystallin, albuminoid, and calcium.

Crystallins. The crystallins, according to some authors, belong to the albumins, while others believe they are more like globulins. Jess concludes that the crystallins should be placed with the albumins, since they are soluble in water, contain 15 percent basic amino acids, 85 percent of monoamino acids and no glycocoll. Adams states that the proportion of diamino to monoamino acids makes the crystallins resemble albumins rather than globulins. On the other hand Woods and Burky classify alpha crystallin with the serum globulins and gamma crystallin with the serum albumins (pseudoglobulin); Krause states that alpha crystallin behaves in dialysis as does pseudoglobulin of the blood. According to Mörner, Jess, and others, the soluble protein fraction is composed of approximately one-third alpha crystallin and two-thirds beta crystallin, along with a small amount of albumin. Mör-

ner found a higher percentage of alpha crystallin in the outer layers of the lens cortex, whereas in the inner layers the beta crystallin predominates. With advancing age there is a gradual reduction, both absolute and relative, in the amount of crystallins; in the senile cataractous lens there is a further reduction. Both crystallins may be hydrolyzed into various amino acids, the most interesting perhaps being the sulphur-containing cysteine. The sulphydryl group of this amino acid, most of which is contained in beta crystallin, has to do with autoxidation of the lens; the presence of this group is determined by the sodium-nitroprusside reaction of Arnold.

Alpha crystallin: According to Mörner sulphur is present in alpha crystallin in a concentration of 0.56 percent, and in beta crystallin in 1.27 percent; Jess' figures are similar, being 0.68 percent and 1.34 percent, respectively. Löwenstein and Haurowitz report that light opacities which occur in cattle lenses immersed in hypertonic salt solution at a *p*H of 6.0, and the total opacity at *p*H 5.0, consist exclusively of alpha crystallin. Krause gives the average composition of dry alpha crystallin as nitrogen 16.66 percent, carbon 52.20 percent, hydrogen 7.18 percent, sulphur 0.608 percent, and 0.409 percent ash. The nitrogen is distributed as follows: total nitrogen 16.71 percent, amid 1.70 percent, humin 2.21 percent, cystine 1.59 percent, arginine 21.88 percent, histidine 5.91 percent, lysine 2.22 percent, aminonitrogen of filtrate 51.18 percent, nonaminonitrogen of filtrate 13.13 percent, and percentage recovered 99.90. The nitrogen distribution in terms of percentage of protein is: amid 0.28, humin 0.36, basic 5.38, and nonbasic 10.73—total 16.74. The basic amino acids in alpha crystallin have values as follows: arginine 11.24 percent, histidine 3.65 percent, and lysine 1.87 percent. In addition he found the amount of cystine to be 2.36 percent by one method and 1.11 percent by another, tryptophan 0.85 percent, and tyrosine 5.31 percent. Krause found that alpha crystallin precipitates at *p*H 5.2; it also precipitates with 24.6 percent ammonium sulphate at 25°C. at *p*H 6.8.

Beta crystallin: Beta crystallin being present in larger amounts, containing more sulphur and giving a stronger nitroprusside reaction than alpha crystallin, probably plays a more important role in the autoxidation of the lens. With advancing age the amount of beta crystallin shows a relative decrease, and with senile cataract, according to Jess and others, the beta crystallin disappears, and there is no reaction with sodium nitroprusside.

Reis found large quantities of cysteine in the beta crystallin of the normal lens, but could find none in mature senile cataractous lenses. Hektoen states that the cataractous lens contains more beta than alpha crystallin. Goldschmidt found a thermostable constituent which Adams identified with beta crystallin. Burky and Woods found that beta crystallin may be purified completely by precipitation of the alpha crystallin in a saturated sodium-chloride solution which is acidified to *p*H 4.6. Krause found that a large part of the beta crystallin precipitates at *p*H 7.2 at 0°C., or in 5 percent sodium-chloride solution at *p*H 6.8 at 61°C., or at *p*H 6.8 in 19.76 to 33.44 percent ammonium-sulphate solution at 25°C.

Albumin (*gamma crystallin*). In the soluble fraction of the lens protein there is approximately 1 percent albumin (Mörner). Burky and Woods reported, in 1928, the finding of an additional crystallin in the lens protein. It is found in 1-percent concentration in the supernatant fluid, after precipitation of the beta crystallin at *p*H 6.0. They were able to prove it is an albumin by precipitation with a 50 percent or stronger ammonium-sulphate solution. In our opinion this is Mörner's albumin.

Albuminoid. Berzelius, according to Adams, found an insoluble fraction in the lens protein known as albuminoid, which is especially concentrated in the nucleus. Mörner states that it makes up 48 percent of the total protein, and corroborates its water insolubility; in addition he finds it insoluble in various salt solutions and alcohol, only slightly soluble in dilute ammonia and acetic acid, but quite soluble in dilute mineral

acids and fixed alkalies. Jess found that albuminoid increases with age; i.e., in youth it is only 18 percent of the total protein, whereas in senility it increases to 59 percent; in cataractous lenses the albuminoid predominates. He quotes Conheim as stating that this protein acts as a framework for the soluble protein fractions.

Mörner analyzed the albuminoid of the lens and found it to contain carbon 53.12 percent, nitrogen 16.62 percent, hydrogen 6.80 percent and sulphur 0.79 percent. Jess believes that albuminoid resembles globulin, even though it contains no glycocoll; he states that there is no sodium nitroprusside reaction, showing an absence of sulphydryl groups. However his analysis shows 0.87 percent sulphur. Woods and Burky identified albuminoid as euglobulin. Recently Krause precipitated out the alpha and beta crystallins and then, from the supernatant fluid, the albumin was precipitated with acetic acid. He gives the make-up of albuminoid as follows: nitrogen 16.67 percent, carbon 52.40 percent, hydrogen 7.18 percent, sulphur 0.7 percent, and ash 0.903 percent. The nitrogen distribution in albuminoid is: total nitrogen 16.41 percent, amid 0.77 percent, humin 0.98 percent, cystine 1.23 percent, arginine 19.02 percent, histidine 6.02 percent, lysine 6.47 percent, aminonitrogen of filtrate 52.09 percent, nonaminonitrogen of filtrate 13.80 percent, and the percentage of recovery as 100.15. The nitrogen distribution in terms of percentage of proteins is: amid 0.12, humin 0.16, basic 5.45, nonbasic 10.64, a total of 16.38. He lists the basic amino acids in albuminoid as: arginine 9.91 percent, histidine 3.30 percent, and lysine 5.62 percent. Cystine amounts to 2.63 percent by one method and 1.25 percent by another; tryptophan 0.713 percent, and tyrosine 6.25 percent. Krause is of the opinion that albuminoid, being insoluble in salt solution, cannot be classified as a euglobulin, neither can it be considered an ordinary albuminoid such as elastin, collogen, or keratin; it may be a modified globulin.

Hydrogen-ion Concentration. The determination of hydrogen-ion concentration is more difficult in tissue, such as the lens, than in fluids; this accounts for the variations in data by different investigators. All physiologic functions occur within extremely narrow *p*H limits, a slight shift to the alkaline or acid side indicating a pathologic state. However it is certain that the reaction of the normal lens is more alkaline than that of the blood by at least 0.1 *p*H unit. The iso-electric point of the whole lens protein is approximately 2 *p*H units below neutrality.

Buglia, in 1927, separated the cortical and nuclear albumins of the normal lens and, by nephelometric examination, determined the *p*H to be 7.64 and 7.14 respectively; after freezing the lens until cold cataract appears, the *p*H in cortical albumins is 7.30 and in nuclear albumins 7.91. Burky and Woods found the isoelectric point of alpha crystallin at *p*H 4.8, and of beta crystallin at *p*H 6.0; there is none for gamma crystallin. Gonçalves found that beef lenses have two isoelectric points, one at *p*H 4.6, and a second at *p*H 8.5. In a later paper (1931) he states that the dioptric power of the lens varies between +15 and —15 diopters with changes in *p*H from 3.8 to 8.5, consequently he believes the optical power of the lens is controlled by the *p*H of the surrounding liquid; there is an internal change in the lens at the first isoelectric point, and a change in curvature at the second. O'Brien and Salit quote Scalinci as authority for the statement that Gullotta was the first to experiment on the isoelectric point of the lens; he found it at *p*H 4.0. Scalinci found the cortex to have an isoelectric point at *p*H 3.5 to 4.0, and the nucleus at *p*H 4.5. In our own experiments on normal adult cattle lenses, the isoelectric point of the entire lens protein is at *p*H 5.16; the *p*H of the cortex is 5.1 and of the nucleus 5.44. Tsuji states that, in the presence of calcium, the isoelectric point of alpha crystallin is more on the alkaline side than that of the entire lens, however the isoelectric point is maintained on the acid side through the antagonistic influence of beta crystallin, sodium, and potassium on calcium. Salit recently determined the *p*H of each of a number of single cattle lenses by use of the hydrogen electrode; the average *p*H is 7.45. He believes that the buffer activity of the lens is such that changes

in p_H take place with difficulty; if the lens is allowed to stand 4 or 5 hours the reaction shifts slightly to the acid side, probably as a result of the formation of amino acids by autolysis of the lens protein.

Amino acids. According to Jess the first publication on amino acids was that of Emil Fischer which appeared in 1901. The protein molecule is made up of a combination of amino acids; hydrolysis of protein splits it into its component parts, the amino acids. Up to the present time 18 amino acids have been isolated from protein, of which number only 15 have been found in the crystallin lens. There are monoamino and diamino acids, i.e., those with one nitrogen (basic) group, and those with two; also monocarboxylic and dicarboxylic acids, i.e., those with one carboxyl (acid) group, and those with two. On account of the presence of both basic and acid groups in each amino acid, they are amphoteric and react with both acids and bases. Of the 15 known amino acids in the lens protein, 10 are monoamino, 2 are dicarboxylic, and 3 are diamino acids. In the present state of our knowledge cysteine-cystine appears to be one of the more important amino acids on account of the sulphydryl (-S-H) group which has to do with autoxidation.

Jess gives the following table of amino acids and their percentages in alpha and beta crystallins and albuminoid:

	Crystallins		Albuminoid
	Alpha	Beta	
Glycocoll (monoamino)	0.0%	0.0%	0.0%
Alanine (monoamino)	3.6	2.6	0.8
Valin (monoamino)	0.9	2.1	0.2
Leucine and isomere (monoamino)	5.9	2.8	5.3
Aspartic acid (dicarboxylic)	1.2	0.4	6.5
Glutamic acid (dicarboxylic)	3.6	2.7	4.6
Tyrosine (monoamino)	3.5	3.7	3.6
Proline (monoamino)	1.8	1.4	1.9
Phenylalanine (monoamino)	5.5	1.4	1.9
Serine (monoamino)	+	+	+
Tryptophan (monoamino)	+	+	+
Cysteine-cystine (monoamino)	2.3	4.9	—
Ammonia	7.1	11.4	6.0
Melanin	1.1	0.1	0.6

Arginine, histidine, and lysine (diamino acids) 15 percent in alpha and beta crystallins, and 17 percent in albuminoid. Arginine is found in the greatest amount in albuminoid (10.26 percent), while alpha crystallin shows 8.0 percent, and beta 7.45 percent.

Hijikata hydrolyzed ox lenses and found 13 cleavage products. Calculated to ash and water-free substance the amino acids are as follows:

Alanine 4.7 percent	Tyrosine 4.5 percent
Valin 1.0	Proline 2.2
Leucine 6.8	Glutamic acid 15.5
Aspartic acid 1.4	Lysine 1.6
Arginine 3.3	Histidine 1.6
Phenylalanine 1.9	Tryptophan present.

The amount of purine bodies is surprisingly low.

Goldschmidt states that in aged persons, following a change in solubility of the amino acids, electrolytes such as calcium may form addition products. Cystine increases 39 percent, ammonia nitrogen 11.3 percent, arginine nitrogen 11.0 percent, histidine nitrogen 63 percent, and lysine 132 percent; melanin nitrogen, basic amino and nonamino-nitrogen remain constant. He concludes that sclerosis of the lens is the result of a decrease in cysteine, an accumulation of lipids and calcium, an increase in water content, and a shifting of the amino acids. Goldschmidt, in another article, states that the cataracts reported by von Szily and Eckstein, in rats on a vitamin-A deficiency diet, were probably due to lack of some of the essential amino acids in the food, especially cystine and tryptophan, since others failed to produce cataracts with a similar vitamin-A deficiency diet. Lieben and Kronfeld reported the tryptophan content of the pig lens as 3-6 percent of the protein. No decrease is noted after exposure of the lens to ultraviolet light or day-

light; however, a decrease does occur if the lens is placed in a 0.5 percent sodium-hydroxide solution and exposed to such lights. Normal and cataractous lenses do not differ in tryptophan value.

Cysteine is an amino acid, the only one so far as is known containing a sulphydryl (-S-H) group, which is believed, by its presence in glutathione, to have to do with internal respiration of the lens. Its presence in a protein is determined by the sodium-nitroprusside reaction. Cysteine is oxidized by the addition of one atom of oxygen to two molecules of the amino acid, forming the disulphide compound cystine and water. Cystine contains no sulphydryl group and does not give the nitroprusside reaction; when reduced it forms cysteine. Cysteine is found in the largest quantities in beta crystallin, in lesser quantities in alpha crystallin, and not at all in albuminoid (Jess, Adams, and others); it gradually lessens in amount with increasing age and is totally absent in mature cataract. Reis studied normal and cataractous human lenses and found that the normal lens contains cysteine; in immature cataract the cortex gives a faint nitroprusside reaction but the nucleus does not, and in mature cataract there is no cysteine, only cystine. Shôji found that beta crystallin gives a marked cysteine reaction, alpha crystallin less, and albuminoid none. He states that Kranz, contrary to Chalupecky's findings, corroborated the findings of Jess and Koschella that the reaction of cysteine is not affected by ultraviolet light. Tassman reports that Abderhalden and Wertheim believe the oxidation of cysteine to be dependent on its reaction to acid. A pronounced acid reaction retards oxidation; with a neutral reaction it takes place quickly, and in an alkaline state it occurs quite distinctly. In the presence of iron, cystine is reduced to cysteine. The nitroprusside reaction is strong at 4°C., but decreases in rising temperatures, and ceases at 100°C. The oxidation of cysteine is hastened by iron, and also by copper, mercury, arsenic, alcohols, chloroform, and ether, but is retarded by lead, nickel, cobalt, cadmium, potassium cyanide, and prussic acid. Light has no influence on oxidation. Weinstein corroborated the findings of Jess, Goldschmidt, etc., by finding that the cysteine decreases with advancing age of the lens. Shôji recently found that the beef and rabbit lens contains an average of 0.1 percent free cysteine, the remainder being in a combined state. Cysteine changes to cystine under the influence of ultraviolet light —15.8 percent in 3 hours. When a lens solution, from which protein is removed, is exposed to ultraviolet light, 13.3 percent of the cysteine changes to cystine. It is questionable whether infrared or visible light has any influence on cysteine. Tsuji agrees with Seki but disagrees with Goldschmidt, since he found no change in the cysteine content in aging lenses. He found, in agreement with Jess, Adams, and Shôji, that the cysteine reaction is strong in beta crystallin, merely positive in alpha crystallin, and absent in albuminoid.

Urea. Urea is present in the lens as well as in all other tissues. It is a product of catabolism of amino acids and its presence in the lens may be due to a local process or it may be due to diffusion. O'Brien and Salit, examining the normal lenses of 2-year-old cattle, found urea varies between 20.11 and 21.4 mg. percent. Schmerl, produced unilateral cataracts in 2 rabbits by massage and, examining the normal and cataractous lenses 3 days later, found rather large amounts of urea in the capsule and small amounts in the lens fibers of the normal lenses, with just the reverse in the opaque lenses. He suggests that, in incipient cataract, the oxygen consumption of the lens increases but the sulphydryl group diminishes, the latter being given up to the aqueous (similar to the observation of Waldschmidt-Leitz and Mothes with regard to other proteins). Therefore glutathione probably activates arginase, which in turn brings about decomposition of the lens protein, resulting in urea. In cataractous lenses glutathione decreases, hence there is also a decrease in urea.

Glutathione. Glutathione, that constituent of the lens which is supposedly responsible for oxidation-reduction or internal respiration, is a complex structure (tripeptid) made up, in so far as is known, of 3 amino acids, namely cysteine, glutamic acid, and glycocoll. This

compound was isolated by Hopkins in 1921 from the muscle of the rat and is apparently present in all tissues; Goldschmidt demonstrated that it is present in the lens and is responsible for autoxidation in this structure. The action of glutathione is not fully understood; however its action resembles that of a catalyst. The active portion of the molecule, according to Heffter and others, is the sulphydryl (-S-H) group contained in cysteine; there is oxidation, with the loss of one hydrogen atom from the sulphydryl group in each of two molecules, resulting in the formation of water and a disulphide (S-S-) compound. The oxidized glutathione now acts as a hydrogen acceptor and, in the presence of a hydrogen donator (reduced glutathione or free cysteine), the reaction is reversed. The glutathione is predominant in beta crystallin, some is present in alpha crystallin, but apparently none in albuminoid. In advancing age there is a gradual reduction in the amount of this compound; in the cataractous lens there is a further decrease until in the stage of maturity it entirely disappears.

Meyerhof and others found a remarkable acceleration of oxidation in the presence of lecithin in the -S-H⇌S-S- system.

Adams states that Ahlgren recognizes the dialyzable constituent of the lens as glutathione; it gives the sodium nitroprusside reaction. The unextracted tissue decolorizes methylene blue rapidly, whereas, extracted (with N/10 sulphuric acid) tissue does so only after the addition of cystine. He concludes that the lens protein has the power to reduce cystine to cysteine, and that the latter is then able to reduce methylene blue. After extracting the lens with N/10 sulphuric acid, until the filtrate no longer gives the nitroprusside reaction, and then drying the residue with alcohol and *in vacuo* over sulphuric acid, the power of the residue to reduce cystine remains unchanged, and it is not destroyed by heat or by exposure to a stream of air. In these respects and in its insolubility in water, the residue entirely resembles the thermostable reducing system found by Hopkins in the muscle of the rat. The system can be destroyed by treatment with 0.5 percent hydrogen peroxide. He found that the lens capsule has a protective action. At the end of a primary reduction, i.e., reduction due simply to glutathione, the blue color of the methylene blue can be restored by readmitting air to the tube; this can be repeated six times. This supports the idea that the oxidation-reduction system of the lens is reversible. Reduction time in human lenses increases with increasing age, and is much accelerated by the addition of cystine. The pathologic human lens contains a thermostable reduction system, but it is not so easily isolated as it is from the ox lens. A lens that has entirely lost its primary reduction power regains it in the presence of cystine. For ox lenses the reduction power is at an optimum at *p*H 8.3, and it ceases at *p*H 6.0.

Goldschmidt, according to Adams, states that the thermostable system serves to reduce the glutathione, after the latter has been oxidized. He believes that in cataractous lenses there is an increase in acidity, therefore oxidation is inhibited; however, in the light of our present knowledge, we believe this to be doubtful. Adams believes with Goldschmidt that the destruction of glutathione is due to radiant energy.

Adams, from her experiments, concludes that: (1) Oxygen uptake is accelerated and increased in the presence of glutathione. It is markedly increased if both linseed oil and glutathione are present.

(2) The power of the lens to utilize oxygen is considerably decreased by drying; it is entirely absent after dialysis, but the addition of a few milligrams of glutathione restores the power to normal.

(3) A thermostable residue, which has no oxygen uptake of its own, can be prepared from the lens; however, with glutathione, it gives a typical oxygen-uptake curve. It reacts also with a combination of linseed oil and glutathione and develops a large and rapid oxygen uptake.

(4) One of the three proteins of the lens; i.e., beta crystallin, functions preeminently as a thermostable residue.

(5) The average glutathione content of an ox lens (Tunnicliffe's method) is 0.305 gm. percent, a high value compared with other tissues.

A decrease in the amount of glutathione is observed after the lens has been exposed to heat rays; the decrease is even more marked after exposure to ultraviolet light. Jess showed that the

nitroprusside reaction is positive after irradiation of the lens; Abderhalden and Wertheimer showed that an increase in temperature accelerates the nitroprusside reaction, also iron, copper, mercury, and arsenic hasten oxidation; potassium cyanide, lead, nickel, cobalt, and cadmium, on the contrary, retard the reaction.

Tassman and Karr state that Arnold, in 1911, showed that the normal lens, when treated with a 5 percent solution of sodium nitroprusside and a drop of ammonia, turns red; the reaction is due to cysteine. Reis and Jess found this reaction negative in those parts which had become cataractous. This was confirmed by Cohen and Killian with 64 cataractous lenses. Goldschmidt found that cysteine decreases with increasing age of the lens. Michaïl and Vancea found a constant value of 356 mg. of glutathione in the lens of the ox, rabbit, and dog (Tunnicliffe's method); this amount is much higher than that found by Hopkins in the liver. Tassman and Karr found glutathione in the normal pig lens averages 0.296 percent; the ratio of cysteine and cystine to be 0.296/0.704. Glutathione is absent from cataract lenses.

Lipids. Several lipids have been identified in the normal lens, the most important of which are cholesterol and lecithin. It is known that the latter two constituents increase with advancing age, and that they are found in the largest amounts in the cataractous lens. Their significance is unknown.

Michel and Wagner give the findings of Simon for fats in the ox lens as 0.045 percent, and in the horse lens as 0.142 percent; those of Kühne as 2.0 percent; and those of Cahn for the normal lens as cholesterol 0.62 percent, lecithin 0.63 percent and fat 0.79 percent, and for the cataractous lens as cholesterol 6.22-4.55 percent, lecithin 4.52-0.803 percent and fat 1.19 percent. Gross states there is practically no difference between the lipid content of dried calf and cattle lenses, calves on an average having a lipid content of 0.24 percent, and older animals a content of 0.29 percent; the ether-soluble portions are 0.63 percent and 0.59 percent, respectively. In the cataractous human lens cholesterol is practically the same as in aged cattle; however, the ether-soluble portion of the lipids is much higher in cataractous lenses. Goldschmidt analyzed 314 postmortem human lenses, after drying to a constant weight: the total lipids increase with advancing age from an average of 2.12 percent in the first year of life, to 6.14 percent in the first decade, and 8.35 percent in the eighth decade. The first maximum of cholesterol is in the first year of life, the minimum in the 2d decade, and the second maximum in the 7th and 8th decades. The phosphatids have a first maximum in the 2d decade, gradually decrease from the 2d to the 7th decade, and again have a maximum in the 8th decade. An acetone-soluble substance is at a maximum (1.0-2.0 percent) at ages 10-20 years, then falls steadily to 0.6 percent at 80 years of age. A benzol-soluble substance is at a maximum (0.4 percent) during the first 10 years of life, then falls to 0.1 percent. Clapp states that Neumeister found a cholesterol value of 0.22 percent, and one for lecithin of 0.23 percent. According to Adams, Leber suggests that lipids may play some part in the onset of cataract, by providing a solvent for such harmful substances as acetone and butyric acid. She mentions the fact that Jacobsen, Kühne and Cahn found increased lipids in pathologic lenses; also that Valentine identified glycerine ester, cholesterol ester, free cholesterol and a cholin-containing phosphatid in the normal lens. Michaïl *et al* believe that the cataractous lens apparently accumulates cholesterol on account of the greater cholesterogenic property of the lens. Bürger and Schlomka, working with normal cattle lenses, determined the fact that cholesterol increases, at first slowly, then rapidly, from 40 mg. percent in calves, to 222 mg. percent in 15-year-old animals; on the basis of dry lens substance the values are 134 mg. percent, and 610 mg. percent, respectively. Hoffmann in 1914, according to Woods, demonstrated myelin in cataractous lenses. Kranz found a myelin-like, doubly refracting substance in the senile cataractous lens; he states that the relationship between the lipids of

senile cataractous lenses and autolytic products does not exist. Berezinskaja assumes that the cholesterol which is found in the cataractous lens, is due to abnormal protein decomposition. Michaïl and Vancea, experimenting with rabbits fed on naphthalene, found an increase in cholesterol in most organs, but a decrease in the lens; they believe this brings about cataract formation and that, when the cataract advances, cholesterol accumulates. Kranz believes the accumulation of lipids in the cataractous lens is brought about by metabolism, and that it is not the result of fatty degeneration. In an examination of 19 cataractous lenses it was found that ordinary senile cataract contains 2.16 percent cholesterol and black cataract 5.58 percent. Neuschüler states that, in a patient with hypercholesterolemia and black cataract, the lens contained cholesterol crystals, but no fats or lipids. Parhon and Werner found the cholesterol content of the lens in thyroparathyroidectomized dogs to vary from 2.50 to 3.86 percent, and in control animals from 2.0 to 3.12 percent. Cahane examined beef lenses and determined the cholesterol content in animals of differing ages, finding an average of 0.10 percent in young animals, and 0.12 percent in older cattle; human lenses were also examined and it was found that the clear lens of elderly persons contains more cholesterol than that of young persons, also that the senile cataractous lens is still higher (0.60 to 0.64 percent) in cholesterol content than the clear lenses. Salit determined the cholesterol content of 46 normal lenses from 2-year-old cattle and found it to be 0.043 percent of the wet weight; in 3 normal human lenses it averages 0.21 percent, and in 26 cataractous lenses cholesterol varies from 0.23 percent to 0.89 percent, increasing with the age of the patient. The lecithin content of normal cattle lenses is 0.11 percent and that of the 26 human cataract lenses ranges from 0.48 to 1.88 percent. Metzger working with polarized light found doubly refracting lipids in 75 post-mortem human lenses, 11 of which had coronary cataract. Updegraff found the cholesterol content of 42 lenses to vary between 282 and 717 mg. percent, with only one lens below 300 and only one above 700 mg. percent; in no case did the content of a supposedly normal lens reach 500 mg. percent.

Sugar. Lottrup-Andersen states that the normal and pathologic lens contains sugar. He believes that the lens of a diabetic contains more sugar than the normal lens, and that during the fasting period it contains more sugar than the blood. O'Brien and Salit determined the sugar content of the lens in 2-year-old cattle—it varies between 126 and 143 mg. percent.

Lens Capsule

The lens capsule is a semipermeable membrane through which there pass nutritional substances and metabolic products. Friedenwald, as had Hess, found the capsule permeable to water, electrolytes, true solutes, and some colloids. These findings, and also the fact that Friedenwald found that permeability decreases with advancing age, were recently confirmed by Gifford, Lebensohn, and Puntenny.

Bibliography

Abderhalden, E. and Wertheimer, E. Studien über Autoxydation. (Versuche mit Cystein und Geweben. Studien über das Wesen der Blausäurevergiftung.) Arch. f. d. ges. Physiol., 1922, v. 197, p. 191.

Adams, D. R. Investigation on the crystalline lens. Proc. Roy. Soc., Ser. B., 1925, v. 98, p. 244.

———. A review of the literature on the crystalline lens. Brit. Jour. Ophth., 1925, v. 9, p. 281.

———. The role of calcium in senile cataract. Biochem. Jour., 1929, v. 23, p. 902.

Becker, O. Graefe-Saemisch Handbuch.

Berezinskaja, D. Cholesterin und Cystin in der Linse. Russk. Ophth. Zur., 1927, v. 6, p. 549; Abstr. Zentralbl. f. d. ges. Ophth., 1927, v. 18, p. 785.

Boente, F. Kalkablagerungen in der Linse. (Mit zwei neuen Spaltlampenbildern.) Arch. f. Augenh., 1931, v. 102, p. 261.

Buglia, G. Sulle cause dalle quali dipende la diversa facilità di opacamento della

sostanza centrale e della sostanza corticale della lente cristallina, nella cataratta postmartale o da freddo. Arch. di fisiol., 1926, v. 24, p. 454.
Burdon-Cooper, J. Pathology of cataract: The hydrolysis theory. Ophth. Rev., 1914, v. 33, p. 129.
———. A report on the spectroscopic examination of the mineral constituents of the human cataractous lens and that of healthy animal lenses. Trans. Ophth. Soc. U. Kingdom, 1928, v. 48, p. 340.
Burge, W. E. Analyses of the ash of the normal and the cataractous lens. Arch. of Ophth., 1909, v. 38, p. 435.
———. The effect of radiant energy on the lens and the humors of the eye. Amer. Jour. Physiol., 1914, v. 36, p. 21.
———. Analyses of the ash of the normal and the cataractous lens. Arch. of Ophth., 1909, v. 38, p. 447.
Bürger, M. and Schlomka, G. Beiträge zur physiologischen Chemie des Alterns der Gewebe. II. Mitteilung. Untersuchungen an der Rinderlinse. Ztschr. f. d. ges. exper. Med. 1927, v. 58, p. 710.
Burky, E. L., and Woods, A. C. Lens protein—New methods for the preparation of beta crystallin. Arch. of Ophth., 1928, v. 57, p. 41.
Cahane, M. Recherches sur la teneur du cristallin en eau et en cholesterol suivant l'âge. Cataracte et cholesterol. Compt. rend. Soc. Biol. Paris, 1931, v. 108, p. 992.
———. Ueber die Schwankungen des Cholesterol und Wassergehaltes der Linse im Alter und bei einigen Krankheiten (Katarakte und Tetanie). Cluj. Med., 1932, v. 13, p. 215. (Germ. abstr. p. 230.)
Cahn, A. Zur physiologischen Chemie des Auges. Ztschr. f. physiol. Chem., 1881, v. 5, p. 213.
Carmi, A. Sulla patogenesi della cataratta nera. Ricerche chimico-biologiche. Boll. d'ocul. 1929, v. 8, p. 1356.
Clapp, C. A. A study as to weight and percentage of solids of cataractous lenses. Arch. of Ophth., 1916, v. 45, p. 574.
———. Liquefaction and absorption of the crystalline lens with its possible relation to lenticular opacities. Amer. Jour. Ophth., 1924, v. 7, p. 131.
Clausnizer, T. Weiterer Ergebnisse von Wägungen der in geschlossener Kapsel entfernten menschlichen Linse. Centralbl. f. prakt. Augenh., 1911, v. 35, p. 262.
Collins, W. J. The composition of the human lens in health and in cataract, and its bearing upon operations for the latter. Ophth. Rev., 1889, v. 8, p. 321.
Corrado, A. Sulla patogenesi della cataratta nigra. Arch. di oftalm., 1927, v. 34, p. 201.
Evans, E. I., and Kern, R. The relation of the parathyroid gland to cataract. Amer. Jour. Ophth., 1931, v. 14, p. 1029.
Friedenwald, J. S. Permeability of the lens capsule. With special reference to the etiology of senile cataract. Arch. of Ophth., 1930, v. 3, p. 182; 1930, v. 4, p. 350.
Gifford, S. R., Lebensohn, J. E., and Puntenny, I. S. The biochemistry of the lens. I. The permeability of the capsule of the lens. Arch. of Ophth., 1932, v. 8, p. 414.
Goldschmidt, M. Die Lipoide der Linse. Biochem. Ztschr., 1922, v. 127, p. 210.
———. Die Autoxydation der normalen und pathologischen Linse. Arch. f. Ophth., 1924, v. 113, p. 160.
———. Ueber physiologisch-chemische Altersveränderungen des Auges. Klin. Monatsbl. f. Augenh., 1924, v. 72, p. 777.
———. Zur Frage der Kataraktbildung bei Vitaminmangel. Klin. Wchenschr., 1927, v. 6, p. 635.
Gonçalves, A. Recherches sur les propriétés physicochimiques du cristallin. Arch. de phys. biol., 1930, v. 8, p. 5.
Heffter, A., and Hausmann, M. Ueber die Wirkung des Schwefels auf Eiweisskörper. Beitr. z. Chem. Physiol. u. Pathol., 1904, v. 5, p. 213.
Hektoen, L. Immune reactions of the lens. Amer. Jour. Ophth., 1923, v. 6, p. 276.
———, and Schulhof, K. Further observations on lens precipitins. Antigenic properties of alpha and beta crystallins. Jour. Infect. Dis., 1924, v. 34, p. 433.
Herbert, H. The practical details of cataract extraction. 1903.
Hijikata, Y. On the cleavage products of the crystalline lens. Jour. Biol. Chem., 1922, v. 51, p. 155.
Jess, A. Zur Chemie der Cataracta senilis. Arch. f. Augenh., 1912, v. 71, p. 259.
———. Beiträge zur Kenntnis der Chemie der normalen und der pathologisch veränderten Linse des Auges. Ztschr. f. Biol., 1913, v. 61, p. 93.
———. Die Monoaminosäuren der Linsenproteine. Ztschr. f. physiol. Chem., 1920, v. 110, p. 266.
———. Die moderne Eiweisschemie im Dienste der Starforschung. I. Teil. Arch. f. Ophth., 1921, v. 105, p. 428; II. Teil. *Idem.*, 1922, v. 109, p. 463.
Kirby, D. B. Calcium in relation to cataract. I. In vitro. Arch. of Ophth., 1931, v. 5, p. 856.
Kranz, H. W. Die polarisationsmikroskopische Untersuchung der kataraktös getrübten Linse. Arch. f. Ophth., 1927, v. 118, p. 571.

Krause, A. C. Chemistry of the lens. I. Composition of albuminoid and alpha crystallin. Arch. of Ophth., 1932, v. 8, p. 166.
Kubik, J. Gewichtsverhältnisse seniler Katarakte. Klin. Monatsbl. f. Augenh., 1929, v. 82, p. 522.
Laptschinsky, M. Ein Beitrag zur Chemie des Linsengewebes. Arch. f. d. ges. Physiol., 1876, v. 13, p. 631.
Levina, L. Die Entstehung des Stars im Zusammenhang mit dem Stoffwechsel. Festschr. f. Prof. Awerbach, 1926, pp. 157-169; Abstr. Zentralbl. f. d. ges. Ophth., 1927, v. 17, p. 539.
Lieben, F., und Kronfeld, P. Ueber die Wirkung der Belichtung auf die Eiweisskörper der Augenlinse. Biochem. Ztschr., 1928, v. 197, p. 136.
Lottrup-Andersen, C. Bestimmung von Linsenzucker. Acta Ophth., 1927, v. 5, p. 226.
Löwenstein, A., and Haurowitz, F. Experimentelle Linsenuntersuchungen. Klin. Monatsbl. f. Augenh., 1929, v. 82, p. 524.
Mackay, G., Stewart, C. P., and Robertson, J. D. A note on the inorganic constituents of normal and cataractous human lenses. Brit. Jour. Ophth., 1932, v. 16, p. 193.
Maynard, F. P. Observations on the weight, volume, and ash of human lenses. Brit. Jour. Ophth., 1920, v. 4, p. 78.
Metzger. Lipoidebefunde bei Cataracta coronaria. Klin. Monatsbl. f. Augenh., 1931, v. 87, p. 850.
Meyerhof, O. Ueber ein neues autoxydables System der Zelle. (Die Rolle der Sulfhydrylgruppe als Sauerstoffüberträger.) Arch. f. d. ges. Physiol., 1923, v. 199, p. 531.
Michaïl, D., Cadarin, I., and Vancea, P. Recherches in vitro sur le rôle du crystallin dans le metabolism de la cholesterine. Compt. rend. Soc. de biol., 1926, v. 94, p. 154.
Michaïl, D., and Vancea, P. Die Blutzuckerkurve bei der Naphthalinvergiftung. Cluj. Med., 1929, v. 10, p. 79; Abstr. Zentralbl. f. d. ges. Ophth., 1929, v. 21, p. 770.
Michel, and Wagner, H. Physiologisch-chemische Untersuchungen des Auges. Arch. f. Ophth., 1886, v. 32, p. 155.
Mörner, C. T. Zur Frage über die Wirkungsart der Eisenmittel. Ztschr. f. physiol. Chem., 1894, v. 18, p. 13.
Neuschüler, I. Della cataratta nigra. Bull. Accad. Med. Roma. 1930, v. 56, p. 134.
O'Brien, C. S., and Salit, P. W. The chemical constituents of the aqueous, vitreous and lens. A comparative study of animal eyes. Extrait du Compte-Rendu du XIII. Concilium ophthalmologicum. Amsterdam—Den Haag, Sept., 1929.
———. Iso-electric point of lens protein. Arch. of Ophth., 1931, v. 6, p. 870.
Parhon, C. I., and Werner, G. Teneur en eau cholestérol calcium et potassium de la peau, cholestérol du cristallin et calcium de l'humeur aqueuse, chez les animaux thyroparathyroidectomisés. Compt. rend. Soc. de biol., 1931, v. 108, p. 991.
Reis, W. Ueber die Cysteinreaction der normalen und pathologisch veränderten Linsen. Arch. f. Ophth., 1912, v. 80, p. 588.
Salit, P. W. Biochemical investigation of the nitrogen, weight and water content of crystalline lenses. Arch. of Ophth., 1931, v. 5, p. 623.
———. Chemical studies of lipids of normal animal lenses, cataractous human lenses and the blood of patients with cataract. *Ibid.*, 1931, v. 5, p. 354.
———. Calcium content and weight of human cataractous lenses. *Ibid.*, 1933, v. 9, p. 571.
Scalinci, N. Il punto isoelettrico delle proteine della lente cristallina. Boll. d. Soc. ital. di biol. sper., 1929, v. 4, p. 359.
Schanz, F. Die Wirkung des Lichtes auf die lebende Zelle. Münchener med. Wchnschr., 1915, v. 62, p. 643.
Schmerl, E. Harnstoffnachweiss in der normalen und pathologisch veränderten tierischen Augenlinse. Klin. Wchnschr., 1932, v. 11, p. 952.
Shôji, Y. Cystéine du cristallin. Ann. d'ocul., 1927, v. 164, p. 344; Fukuoka-Ikwadaigaku-Zasshi, 1927, v. 20, p. 6.
———. Sur la cystéine du cristallin et ses rapports avec les rayons ultraviolets. *Ibid.*, 1931, v. 24, p. 14.
Smith, Priestley. Diseases of crystalline lens and capsule. 1. On the growth of the crystalline lens. Trans. Ophth. Soc. U. Kingdom, 1883, v. 3, p. 79.
Tassman, I. S. The proteins of the lens and their chemical changes in the pathogenesis of senile cataract. Arch. of Ophth., 1928, v. 57, p. 361.
———, and Karr, W. G. Glutathione in the crystalline lens. Arch. of Ophth., 1929, v. 2, p. 431.
Tsuji, T. Experimentelle Untersuchungen über das Linseneiweiss bei Katarakt. Jour. Biochem., 1932, v. 15, p. 33.
Updegraff, H. Calcium phosphorus and cholesterol in cataractous vs. apparently normal lenses from human eyes. Proc. Soc. Exp. Biol. and Med., 1932, v. 29, p. 964.
Vlès, F., and Gonçalves, A. Recherches sur les propriétés optiques du cristallin liées au *p*H. Arch. de Phy. biol., 1931, v. 9, p. 142.
Weinstein, P. Zur Frage des physiko-chemischen Entstehungsmechanismus der Kat-

arakte. (Untersuchungen der Cystein Reaction der Augenlinse und der Linsenkapsel.) Klin. Monatsbl. f. Augenh., 1931, v. 89, p. 393.
Woods, A. C. Clinical and immunologic researches on lens protein. Arch. of Ophth., 1930, v. 4, p. 96.
———, and Burky, E. L. Lens protein. The isolation of a third (gamma) crystalline. Arch. of Ophth., 1928, v. 47, p. 464.

Discussion: DR. ALAN C. WOODS: I would like to ask if you have done any work, either confirming or extending in any way the carbohydrate findings in the lens?

DR. P. W. SALIT: We have made determinations of the sugar content of normal animal lenses and found that it is a great deal higher than that of vitreous and slightly higher than that of aqueous and blood.

DR. WOODS: How about cataractous lenses?

DR. SALIT: We have not done any work on cataractous lenses, although it would be very instructive to carry out such experiments. Sugar determinations on cataractous lenses, I expect, would be more difficult on account of the small size of the lens and the fact that cataractous lenses do not lend themselves as easily to maceration and emulsification as normal lenses.

DR. ARNOLD KNAPP: I would like to ask whether there is an actual increase in the calcium content of the cataractous lens or simply an increase in percentage?

DR. SALIT: There is an actual increase in calcium. The analysis was carried out on each single lens and showed that the cataractous lenses increased in calcium in spite of decrease in weight.

DR. KNAPP: Do you have any explanation as to the character of the process or processes?

DR. SALIT: Of course one can speculate a great deal about the deposition of calcium in the cataractous lens. We know that calcium combines with fats forming insoluble soaps, and that there is an increase in fats in cataractous lenses. Calcium also forms insoluble compounds with phosphates, such as tricalcium phosphate and calcium ammonium phosphate, and I would almost think that calcium can form some sort of a compound with protein in the way sodium and potassium form salts with amino acids.

DR. EMORY HILL: Do your researches throw any light on the development of diabetic cataract?

DR. SALIT: We have done some work on the iso electric point of the whole lens protein, partly with the view of throwing some light on the formation of opacities in diabetic cataract. The lens protein coagulates completely at a p_H of 5.16, which is only two p_H units below the normal reaction, i.e., two p_H units on the acid side. Such a change, of course, never takes place in the living body, but we must consider that the precipitation is a gradual one; it has already begun at the point of neutrality and becomes more pronounced with increase in acidity. If the normal lens is macerated in distilled water and thus its crystalline structure destroyed, the lens protein turns slightly opaque. So we think that, once the crystalline structure of the lens has suffered damage, the lens protein easily precipitates with the least shift of the reaction toward the acid side.

We also know that in diabetes there is the formation of acetone bodies, such as acetone, aceto-acetic acid, and beta-hydroxybutyric acid. It has been shown by other workers that the organic acids are more effective in coagulating the protein than the mineral acids, such as hydrochloric, sulphuric, and nitric acids.

A further point to be considered is the abnormally high loss of water due to the elimination of the free sugar in the body. In consequence of this there is a general dehydration of tissue, undoubtedly involving also the lens.

METABOLISM OF THE NORMAL AND CATARACTOUS LENS

PETER C. KRONFELD, M.D.
CHICAGO

Since there is in the body no structure analogous to the lens its metabolism cannot be expressed in terms of any organ, but comparisons are self-limited. Metabolic activities are greatest near the surface of the lens and decrease gradually toward its center. The glycolysis of approximately 2.4 mg. and the consumption of 0.3 mg. of oxygen is performed by the normal lens per day, representing 1 percent and 0.25 percent of the total energy exchange of the eye. The metabolism of the cataractous lens is very incompletely known, for the specific toxicity of the experimental agent is not definitively known. Read before the Association for Research in Ophthalmology in Milwaukee, June 13, 1933. From the Eye Clinic of the University of Chicago, E. V. L. Brown, Director.

On behalf of the biochemists who have been studying the metabolism of the lens, I wish to thank the program committee and the members of the society for inviting us to take part in your symposium on the etiology of senile cataract. We are greatly honored by your invitation, which, however, we do not quite deserve. Our present knowledge of the metabolism of the lens is still so incomplete and sketchy that it can hardly be a proper subject of discussion before this forum of American ophthalmologists. It rather seems to me that only laboratory workers during their highly informal monthly laboratory teas could get any satisfaction out of discussing this subject, which, at the present time is still full of technical problems. The little we know, is mainly qualitative in the sense of the chemist, and the facts concerning the chemistry of cataract are mainly accessory or parallel in character and do not by any means allow definitive conclusions to be drawn concerning the first and main cause of cataract. I shall, however, endeavor to present the facts before you, without trying to cover up their meagerness and sketchiness with a glistening coat of theories.

That the lens actually has a considerable metabolism has been almost generally inferred from the fact that it does depend upon a certain amount of food supply. This was evidenced by the experiments of Wagenmann[1] in which the circulation in the anterior segments of rabbit eyes was impaired by shutting off from one to all of the posterior ciliary arteries. Unfortunately, it is as yet unknown to what extent the obstruction of those vessels alters the CO_2 and O_2 tension in the aqueous and also the *finer* structure of the lens *in vivo*. Grossly speaking, the lenses remained clear *intra vitam*, but showed anatomical changes that were interpreted as signs of temporary slight damage to the anterior lens epithelium. In only one rabbit did Wagenmann observe the development of an "incipient" cataract several months after the experiment on the posterior ciliary vessels. In one other case the effect of the operation was unusually severe and consisted of a partial atrophy of the iris and ciliary body together with a very acute formation of complete cataract.

These experiments prove at least that the lens demands a certain degree of arterial blood supply to the neighboring structures for the maintenance of its transparency. It is to be hoped that by the application of slitlamp microscopy and of modern biochemical methods (like the air-bubble methods of J. Friedenwald[2]) to future experiments of this kind, quantitative relations between the O_2 content and O_2 supply to the aqueous and lens changes will be established. Statements like "the *slightest* interference with the circulation of the eye leads to degenerative changes in the lens"[3] do not seem quite justified at the present time.

In view of the dependence of the lens upon food supply, one might ask what is the purpose of the metabolic processes in the lens. At the present time it can be said only that a certain amount of nourishment or potential energy seems necessary to maintain life in the epithelial cells, and normality both of structure and elasticity in the lens fibers. Whether the *number of living cells* in the lens increases during extra-

uterine life seems questionable.[4] It has, however, been proved that the lens substance or the absolute amount of specific protein increases steadily up to the stage of senile cataractous changes. The formation of the specific and characteristic proteins of the lens may be said to be a vital activity of the lens. The proteins present in the aqueous cannot be used directly because they are the specific proteins of the blood. The lens therefore has either to build up its specific protein molecules from the amino-acids present in the aqueous, or to break down the plasma proteins to smaller nonspecific compounds of several amino-acids before they can be used for building the specific lens protein.

The change in shape that the lens undergoes during the process of accommodation, is thought to be passive in nature by the advocates of the various theories on accommodation. An unusual amount of elasticity of the lens substance is, however, required, which may call for a higher degree of metabolism.

How active a life the anterior lens epithelium is leading cannot be expressed in scientific terms at this time. Its permeability is apparently nonselective in character. Whether it plays a role in maintaining the anatomical and chemical integrity of the lens against the difference in osmotic pressure between lens and aqueous is unknown.

This brings up the question as to which portion of the lens actually lives or, rather, which portions show metabolic activity. The lens epithelium doubtless lives and is the site of the bulk of the lens activities. From the biochemist's point of view, I have to state here that the capacity of performing some of the chemical reactions that will be described in this paper is present in the lens-substance also, and to a smaller extent even in the nucleus of the lenses of aged animals. Schematically speaking, I might say at this time that the metabolic activities are greatest near the surface and thence decrease gradually toward the center of the lens. More complete knowledge of the metabolic activities of the lens will perhaps enable us to make the differentiation between active and inert portions of the lens more precise.

The lens is, therefore, highly inhomogeneous, in so far as the metabolic capacities of its morphological elements are concerned. This fact makes comparisons with other organs very difficult. The lens really has no anatomically analogous organ, hence its metabolism cannot be called small or great because of the lack of an object for comparison. The word "considerable" metabolism of the lens as it is used in biochemical papers therefore only expresses the fact that the metabolism is measurable and greater than anticipated by the respective examiners. For the study of the lens metabolism and the calculation of the final data, two possibilities offer themselves: (1) Study of the lens as a whole and expression of findings per one intact lens of a certain age. (2) Study of macerated or ground lenses from animals of certain ages. Thus the proportion between active and relatively inert portions of the lens is kept approximately the same in all experiments.

By *metabolism* the biochemist means the chemical processes which the various foodstuffs undergo between absorption and excretion. Its study, therefore, begins with that of the absorption of foodstuffs from the surrounding fluid. In the case of the lens this process is carried out by the uptake of certain substances from the aqueous and their diffusion through the lens capsule. The same mechanism applies to the process of excretion. The aqueous, therefore, if it were stagnant and no provisions were made for exchange of water and dissolved substances with the circulating blood, would to some extent indicate the metabolism of the lens *in vivo*. The above-mentioned conditions, however, are not fulfilled in the living eye. The aqueous indicates only in one respect the activities that are going on in the lens, and that is in the carbohydrate metabolism. F. P. Fischer[5] found the lactic-acid content of aphacic eyes (rabbits) invariably lower than that of their normal mates, which fact indicates that the production of lactic acid per

hour by the lens is in excess of the amount that can leave the eye in one hour. This is one of the instances that points out the quantitative limits of outflow of dissolved agents from the eye.

I have found in two cases of retention glaucoma that the aqueous glucose was very low. In an aphakic eye with retention glaucoma the glucose content of the aqueous was within normal limits. The eye affected with retention glaucoma apparently shows a constant glucose deficit unless the lens is absent. This observation indicates an uptake of glucose per hour by the lens greater than the amount of glucose that—in the eye with retention glaucoma—can enter the intraocular fluid in one hour.

From these considerations it is clear at once that a surviving lens surrounded by a stagnant fluid having the composition of the aqueous is an ideal object for metabolic studies. The removal of the lens from the living eye can be accomplished without any trauma other than severing the zonula fibers. The dissection is done with the whole eye immersed in artificial aqueous of normal aqueous temperature so that the lens can be transferred into *in vitro* conditions with less disturbance than any other living organ.

Experiments of this kind have been performed by various investigators, with the purpose of determining the oxygen consumption of the lens. Table 1 indicates that the surviving lens without any doubt has a measurable oxygen uptake that varies considerably depending apparently upon the various conditions under which the experiment was done. The conditions in the research of Kronfeld and Bothman rather closely approximated those present *in vivo*.

The next logical step in analyzing the metabolic activities of the lens was to search for the chemical substrate for the oxygen uptake which may be either autoxidizable substances or oxidizing (or dehydrogenizing) enzymes; that is, oxydases and dehydrogenases. Both have been found and extensively studied in the lenses of laboratory animals, partly also in human cataracts.

Through the efforts of Reis (1912), Jess (1920), Goldschmidt (1917 and 1924), Adams (1925), Tassman and Karr (1929), H. Gifford (1932)[6], we have learned that the normal lens contains an autoxidation system whose active part is the cysteine molecule, which in the presence of free oxygen or any hydrogen acceptor (reducible substances like methylene blue) is readily oxidized into cystine. According to O. Warburg's theory this process is catalyzed by the presence of minute amounts of iron, which is practically ubiquitous in living organisms. The cysteine was found to be present in two forms in the normal lens, namely (a) as free, dialyzable and easily extractible amino-acid, most likely always attached to glutamic acid, and therefore called glutathione, and (b) somehow bound to one of the proteins of the lens. The second factor also gives a positive reaction with sodium nitroprusside which indicates the presence of a free -S-H group, but does not directly reduce methylene blue. If very small amounts of glutathione or any amount of the oxidized cysteine, namely cystine, is added to dialyzed or extracted lens tissue, methylene blue is reduced again. The lens apparently has the capacity of reducing cystine to cysteine, owing to a substance in every respect analogous to the thermostable reducing system that Hopkins found in muscle tissue and which in combination with free glutathione represents a very active and inexhaustible oxidation-reduction or internal-respiration system. The absolute concentration of glutathione in the lens is about 0.356 gm. percent while the muscle of the rabbit contains only 0.042 gm. percent. This looks like an amazingly large amount for the lens, if one considers the vast extent of the metabolic processes that are going on in the muscle.

The action of this internal-respiration system does not depend upon the presence of any living cells or their products. It is a "mere" chemical process (Goldschmidt[7]), determined in its direction and extent by the relative concentrations of the two constituents, by the *p*H and probably by the O_2 tension or

local O_2 demand. The last factor will have to be defined a little more clearly.

The oxidation of cysteine to cystine and the opposite process of reduction do not furnish or liberate an appreciable amount of energy that could be used in the metabolism of the lens. Nor does the cysteine-cystine respiration model when studied in isolation from living tissue, promote or instigate the oxidation of carbohydrates or of the various fatty acids and their derivatives which occur in biological milieus from the breaking up of the carbohydrates. The presence of biological catalyzers or enzymes, in our cases of oxydases and dehydrogenases is necessary to attack the carbohydrates. The experiments of Ahlgren, Adams, Lo Cascio, and Kronfeld and Bothman[6] have shown that the lens possesses enzymes of the kind that splits glucose into lactic acid and dehydrogenate lactic, fumaric, malic, and succinic acids. Carbon dioxide and water, the end-products of the combustion of carbohydrates, have never been demonstrated in the lens metabolism. Of the intermediate products, only one has been studied extensively, namely lactic acid which is known to play a very important role in the carbohydrate metabolism of other living organs.

The formation of lactic acid out of glucose by the lens was first shown by me[8] in collaboration with Bothman and later on confirmed by Cohen and Killian,[9] and also by Michaïl and Vancea[10]. Lactic acid was formed with and without adding carbohydrates, which was not surprising if one considers the 100-mg.-percent average content of carbohydrates in the lens, which furnishes ample material for glycolysis. The latter process has all the characteristics of an enzyme reaction. Freezing of the fresh lens eliminates the glycolysis completely, narcotics hamper it according to their general effect on living cells. We must be aware of the fact that glycolysis represents only one phase of carbohydrate metabolism. From determining the amount of glucose utilized and the amount of lactic acid formed by the surviving lens under conditions as similar as possible to those *in vivo*, we do not learn how much of glucose has been "burned up." From recent developments in our knowledge of muscle metabolism we know that the whole process of utilization of carbohydrates by isolated organs is extremely complicated and that no simple formula can be given. Many phases other than the formation of lactic acid, will have to be studied on the lens before an approximate idea of the total metabolism of the lens can be given. Until then I believe that estimates of the glycolysis of the lens may serve as a temporary measure because I have been able to get very constant values for normal rabbit lenses during the first three hours following removal of the lens. The amount of glucose utilized and of lactic acid liberated seems to be about 0.1—0.2 mg. per hour per lens, depending upon size or age of the lens. Cohen and Killian found rather wide differences between the amounts of sugar that disappeared and the corresponding lactic acid that was formed. I shall discuss this question in a separate paper. Michaïl and Vancea, using chemical methods, demonstrated that the nucleus of the ox lens also shows a considerable amount of glycolysis, slightly greater than that of the superficial cortex. This fact is not surprising if one realizes that glycolysis is an energy-liberating chemical process that requires no oxygen for its maintenance. The most interior portion of the lens, that farthest away from the source of oxygen, the aqueous, apparently has some metabolic activity which is pure glycolysis without consumption of oxygen (see Schmerl's findings in table 1).

From the above-mentioned facts, the following summarizing description of the metabolism of the normal lens can be given: The lens is suspended in a fluid of a p_H value of 7.3 and an oxygen tension of 20-40 mm. Hg (equalling that of the venous blood, de Haan,[11] or 50 mm. Hg according to J. Friedenwald[2]). The aqueous contains an oxidation-reduction system of unknown chemical composition (not of the -S-H type Müller[12]). Glutathione does not occur in the aqueous of eyes with normal lenses. Some of the oxygen of the aqueous diffuses into the lens and there

Table 1

	Apparatus	Animal State of Lens	Results (O_2 consumption per hour)	Surrounding Fluid and Gas	Temperature degrees C
Mashimo 1923	Winterstein respirometer	Rabbit Whole lens	6–9 c.mm.	Normal saline or Ringer, in O_2	14–20°
		Whole lens with torn capsule	23–32 c.mm.	Same	14–20°
		Rabbit Whole lens	60 c.mm.	Same	30°
		Human cataractous lenses (nuclei with some cortex)	3–25 c.mm.	Same	20°
D. Adams 1925	Barcroft respirometer	Ox Whole lens	65 c.mm. during the first hour, slowly decreasing to nil after 5 hours	Ringer plus phosphate or borate buffer, in air, CO_2 absorbed, p_H = 7.6	35°
		Whole lens dialyzed	Nil		
		Whole lens dried	Very little O_2 consumption		
		Suspension of finely ground fresh lens	The same type of curve as the fresh whole lens, but more rapid		
Kronfeld-Bothman 1927	Warburg direct method	Rabbit Whole lens	Smallest values 4–8 c. mm. O_2 per hour; greatest values ca. 30 c.mm. O_2 per hour	Ringer CO_2 absorbed	37°
	Differential method	Rabbit Whole lens	About the same variations	Ringer plus glucose in 5% CO_2 in O_2 or N_2	37°
		Pig Whole lens	15–30 c.mm. O_2 per hour	Same	37°
Schmerl 1927	Warburg direct method	Rabbit Whole lens	4 c.mm.	Ringer in air, CO_2 absorbed	37.5°
		Whole lens with torn capsule	7–8 c.mm.	Same	37.5°
		Rabbit. Whole lens in early stage of naphthalene poisoning	7–20 c.mm. Not increased by tearing the capsule	Same	37.5°
		Normal rabbit nucleus of normal lens	Nil	Same	37.5°
Schmerl 1929	Warburg direct method	Man Whole hypermature cataract	Nil	Same	37.5°

(Table 1 Continued)

	Apparatus	Animal State of Lens	Results (O_2 comsumption per hour)	Surrounding Fluid and Gas	Temperature degrees C.
Schmerl 1929	Same without shaking	Rabbit Whole lens	9–23 c.mm. depending upon size of respirometer	Blotting paper soaked with Ringer, in air (CO_2 absorbed)	37.5°
		Rabbit Whole lens	13–26 c.mm. also depending upon size of respirometer	Same, in O_2	37.5°
		Rabbit Whole lens naphthalene cataract	41–51 c.mm.	Same, in air	37.5°
		Rabbit Whole lens days to months after exposure to x-rays	Slightly but not consistently higher than the normal mates	Same, in air	37.5°
		Rabbit Whole lens, massage cataract	Slightly higher than the normal mates	Same, in air	37.5°

meets the "free" glutathione. What the distribution and state of solution of glutathione is in the normal undisturbed lens colloid, is entirely unknown. From the anatomy of the lens it is at least probable that every lens fiber represents a more or less separated system in which the process of oxidation of cysteine to cystine goes on, depending on the above-mentioned factors. Thus the oxygen is stored in the tissue, the oxidation-reduction system is loaded up to the point of chemical equilibrium.

At the same time the lens in order to liberate energy, attacks its supply of carbohydrates. Some of this process is glycolytic, some of it oxidative in nature. The necessary oxygen is furnished either by direct reduction of the oxidized glutathione or by the action of the thermostable reducing system. Therefore, to get a quantitative idea about the entire extent of the metabolism of the lens, one could use the amount of glycolysis plus the oxygen uptake as a measure, if one could be sure that the oxidation of glutathione would not go beyond the amount required for the oxidation of the carbohydrates used up during that period. If the conditions *in vitro* could be arranged exactly like those prevailing *in vivo*, then the oxygen uptake would probably be as close a measure of the lens metabolism as we can find at the present time. Unfortunately, it happens very often that in experiments on the surviving lens, because of the necessary shaking of the respirometer, small tears develop in the capsule and thus the contact between the oxygen and the glutathione in the lens is rendered much closer than under normal circumstances. It is also possible that the permeability of the lens capsule is altered by the severing of the zonula fibers and transplantation into the new milieu. A criterion of whether the permeability of the lens was altered or not in those experiments could be the reaction for -S-H groups in the artificial aqueous which always remains negative in the normal aqueous that surrounds a normal lens.

Based upon these considerations, I have come to the conclusion that the smallest O_2 figures obtained from the intact surviving lens are most likely the correct ones; the higher figures indicate only alterations in the anatomy of the lens which bring the oxygen into closer contact with the glutathione. The

smallest figures found are between 5 and 10 c.mm. O_2 per hour and lens (rabbit), which is about 10-20 times the amount of oxygen present in the anterior chamber of the rabbit. A very rapid flow of oxygen from the bloodstream into the aqueous therefore seems necessary, which is one of the reasons why J. Friedenwald postulates a secretion of oxygen into the aqueous as the result of a vital activity of the ciliary body. This consideration easily explains the close dependence of the lens upon the functional integrity of the ciliary body, which is suggested by many clinical observations, among which I would just mention the occurrence of a rather rapidly progressive cataract after an extensive cyclodialysis.

Knowing about the metabolism of the normal lens, it was very interesting to compare it with the total energy exchange in the eye (F. P. Fischer[13], A. Meesmann[14]). To determine the latter, the following data were necessary:

(1) The amount of blood flowing through the eye of the rabbit per hour.

(2) The O_2, CO_2, glucose, and lactic acid content of the blood in the carotid artery and in the vortex vein.

In determining factor 1, one has to confine oneself to the blood flowing through the uveal tract. That amount could be estimated by inserting a capillary pipette into one vortex vein and measuring the outflow during several seconds. The amount thus found had to be multiplied by four to conform to the outflow from the four vortex veins. Thus, for a normal rabbit of approximately 2000 gm. weight and 3 gm. bulbus weight, the average of blood flowing through the uveal tract of one eye per day was found to be 1.7 litres. Comparing the loss in oxygen with the increase in carbon dioxide in the arterial (carotid artery) and venous w. vorticosae blood, a respiratory quotient of 1.00 was obtained indicating that the eye was utilizing mainly carbohydrates. The chemical analysis of the two blood samples furnished the quantitative data, namely, a daily consumption of 0.438 gm. glucose, half of which was oxidized and half of which split into lactic acid. These figures bring the metabolism of the eye, if expressed per gram of vascularized structures, into the near neighborhood of that of the brain. One lens glykolyzes approximately 2.4 mg. of glucose per day and consumes 0.3 mg. of oxygen, the former being 1 percent, the latter 0.25 percent of the total energy exchange of the eye, which represents a proportion compatible with the idea of the clinician concerning the share of the lens in the metabolic activities of the entire eye. It might be well to remember here that the relatively small amount of lens metabolism in comparison with that of the whole eye does not justify the conclusion that the lens is insensitive to a diminution of even this slight amount.

The Metabolism of the Cataractous Lens

Here our knowledge is very incomplete (table 2). In the early stages of experimental cataract (naphthalene, massage, and roentgen-rays) Schmerl[15] found the oxygen uptake somewhat, though not consistently, increased. The permeability of the capsule is increased in those cases as evidenced by the positive sodium nitroprusside reaction in the aqueous. The increased oxygen uptake may therefore mean only the liberation of glutathione within the lens and disturbance of the cysteine-cystine equilibrium because of precipitation, i.e., elimination of some of the proteins.

The later stages of naphthalene cataracts show gradual loss of the glutathione, and of human senile cataracts, loss of glutathione and of the thermo-stable reducing system. The progression of the cataract and the loss of the glutathione can at the present time be called only approximately parallel (H. Gifford[16]). The conclusion that the internal-respiration system suffers before the anatomy of the lens becomes visibly disturbed, is not justified at this time.

Ophthalmologists have been hoping for a long time that the solution of the cataract problem may come through biochemical studies of animals in the state of naphthalene poisoning. The last few years have been very discouraging in this respect. Naphthalene is by no means a specific lens poison. It alters the function of the ciliary body (Kom-

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Table 2

	Normal Lenses	Naphthalin Cataract	Senile Cataract
Glutathione determined after Tunnicliffe	0.296 gm.% average in the pig lens (Tassman-Karr); 0.305 gm.% average in the ox lens, decreased after exposure of the first lens to heat or ultraviolet rays (Adams); 0.431 gm.% average in normal rabbit lenses (H. Gifford); 0.356 gm.% average (Michaïl and Vancea); decreasing with age (Goldschmidt).	Amount decreasing with the progression of the cataract (H. Gifford); absent (D. Adams)	Absent (nuclei plus some cortex) (H. Gifford); absent (Tassman-Karr).
Autoxidation system determined after Thunberg (Methylene Blue)	Present in the lenses of pig, ox, sheep, rabbit and man; practically identical with Hopkin's glutathione.	Decreasing with the progression of the cataract (Michaïl-Vancea)	No reduction (H. Gifford); decreased in immature cataracts, absent in later stages and in the nucleus of any stage (Goldschmidt).
Thermostable reducing system	Also present in the above-mentioned species, perhaps identical with beta crystallin (Adams).		As a rule absent (H. Gifford); present in most of the immature and mature cataracts, absent in hypermature ones, absent in the nucleus of cataractous lenses of any stage (Goldschmidt).
Oxydases and dehydrogenases	Present, decreased by exposure to ultraviolet light (Adams).	Not determined.	Not determined.
Glycolysis	Considerable (Kronfeld-Bothman, Cohen and associates); the nucleus of a normal lens also splits glucose (Michaïl-Vancea).	Not determined.	Not determined.

ura[17]) and leads to the well-known, very extensive retinal changes which precede the development of the cataract. The problem is therefore more complex than that of senile cataract. Besides, it is almost certain from the very thorough work of D. Adams[18] that naphthalene or its known derivatives, as they are found in the blood and urine of poisoned rabbits, represent no specific chemical toxins. "The ocular lesions are in themselves of such a nature as to suggest that they may be due to a disturbance in the normal physiological balance of the body" (D. Adams).

The system cysteine-cystine is specifically concerned in chemical reactions with arsenic, copper, gold, cyanide, and methylene blue. Chronic poisonings with arsenic and copper are well known in man; as far as is known, cataracts have never been observed in those cases. Too little is known about the cataracts produced by thallium or ergot poisoning to permit any conclusion as to their possible chemical mode of development.

A very pure picture seems to be that of tetany cataract following extirpation of the parathyroids in dogs and rats. According to Goldmann[19] the lens opacities in that disease develop in very close relation to the convulsions, which indicates the effect of a toxin acting on the lens during the convulsions. The observations on the lens therefore support the intoxication theory of tetany. The alleged toxin, guanidine, seems to have some effect on the respiration of the lens (unpublished experiments, Kronfeld). At the time being, I have not reached any conclusions.

A little more transparent are the effects of radiant energy on the glutathione and on the lens enzymes. Ultraviolet rays reduced the amount of glutathione and hampered the dehydrogenation of organic acids by the lens in some experiments of Adams. Roentgen rays have a very pronounced lowering effect on the glycolysis of the skin (Ginsberg[20]) which most likely also applies to the lens. It is therefore possible that roentgen-cataract is caused by an action of the rays on the lens enzymes.

It is impossible to predict at this time how close to an understanding of the cause of cataract we can come with biochemical methods. We may end up at a closed gate if it should turn out to be the production of enzymes by the living cells that is influenced by the various physical or chemical agents used for the production of cataract. At this time it looks as though it would be a life long task for several men if all the trails pointed out by our present knowledge concerning the metabolism of the lens are to be followed.

References

[1] Wagenmann, A. Arch. f. Ophth., 1890 (December), v. 36, pt. 4, p. 1.
[2] Friedenwald, J. Trans. Amer. Ophth. Soc., 1933.
[3] Adams, D. Brit. Jour. Ophth., 1925, v. 9, p. 284.
[4] Busacca, A. Arch. ital. di Anat. e di Embriol., 1924 (December), v. 21, no. 4, p. 562.
[5] Fischer, F. P. Erg. d. Physiol., 1931, v. 31, p. 507.
[6] See the bibliography in Duke-Elder's Textbook of ophthalmology. London, Henry Kimpton, 1932, p. 481.
[7] Goldschmidt, M. Arch. f. Ophth., 1924, v. 113, p. 160.
[8] Kronfeld, P. C., and Bothman, L. Ztschr. f. Augenh., 1928, v. 65, p. 41.
[9] Cohen, M., and Killian, J. A. XIII. Concilium ophthalmologicum, Amsterdam, 1929, v. 1, p. 166.
[10] Michail, D., and Vancea, P. Compt. rend. Soc. Biol., Paris, 1931, v. 106, p. 495.
[11] de Haan, C. Arch. neerland. d. Physiol., 1922, v. 7, p. 245.
[12] Müller, H. K. Deutsche ophth. Gesellsch., Leipzig, 1932, v. 49, p. 168.
[13] Fischer, F. P. Deutsche ophth. Gesellsch., Heidelberg, 1930, v. 48, p. 95.
[14] Meesmann, A. Deutsche ophth. Gesellsch., Heidelberg, 1930, v. 48, p. 99.
[15] Schmerl, E. Arch. f. Ophth., 1929, v. 122, p. 488.
[16] Gifford, H. Arch. f. Ophth., 1932, v. 7, p. 763.
[17] Komura, K. Arch. f. Ophth., 1928, v. 120, p. 766.
[18] Adams, D. Brit. Jour. Ophth., 1930, v. 14, p. 545.
[19] Goldmann, H. Arch. f. Ophth., 1929, v. 122, p. 146.
[20] Ginsberg, J. E. Personal communication.

Discussion: DR. ARNOLD KNAPP: I would like to ask if the protolytic ferments, other than the glycolytic, have anything to do with respiration.

DR. KRONFELD: In my experience, the amount of proteolysis that goes on in the first two or three hours after removing the lens from the living eye and treating it the way I did, keeping it in a respirometer at body temperature at the physiological *p*H and physiological Co2 tension, is practically negligible. In other words, it does not seem as though during those first two or three hours the lens were breaking up protein and increasing the number of free amino acids.

DR W. H. WILDER: I would like to ask for a little more discussion by the essayist on the subject of the possible effect of dysfunction of the parathyroids upon the metabolism of the lens in cases where there has evidently not been enough disturbance of the function of the thyroid to bring on tetany or these tetanic convulsions.

DR. KRONFELD: My experience is based mainly on grown up laboratory animals and for those it seems to hold true that if you can prevent convulsions, you will get no cataract. To prevent the convulsions, you use a very low protein diet and calcium. In human pathology, it seems to be different. In other words, you see states of so-called latent tetany in which no convulsions actually occur, in which the electrical sensitivity of the muscle is only slightly increased and still you get a cataract. But I know very little about that condition in humans.

THE RECESSION OPERATION FOR STRABISMUS

R. J. CURDY, M.D.
KANSAS CITY, MISSOURI

The advantages of the horizontal incision in conjunctiva and Tenon's capsule, and of direct suturing of the muscle tendon to the sclera in the recession operation are considered, together with the necessity of limiting the recession to the anterior quadrant of the globe.

During the years when tenotomy was the only operation for strabismus many variations of the details of the operation were devised, among them control sutures designed to prevent over effect and late divergence. The control sutures were of the bridle or sling type, looped or tied in the muscle tendon and then anchored in the sclera, or tendon stump, or conjunctiva, at some distance from the cut tendon. Their purpose was to prevent excessive retraction of the tenotomized muscle, but with expectation of adhesion of the tendon to the sclera, though Beard[1] said, "Of course the tendon does not reunite to the globe, but to its aponeurosis." These control sutures were doubtless helpful, but not sufficiently to check the supplanting of tenotomy in general favor by the newer operation of advancement, and later tucking and resection. In the earlier advancement operations the use of the bridle type of suture persisted. The obvious advantage of suturing the tendon directly to the spot where adhesion is desired seems not to have been considered until 1911, when Jackson[2] pointed out its merits in advancement operations and at the same time showed the superiority of the horizontal conjunctival incision in operations on the lateral muscles. He also used direct scleral fixation in his transplantation of the superior rectus tendon. In the later advancement operations direct fixation has become the rule.

A method of recession of the muscle tendon with a horizontal conjunctival incision and with direct scleral fixation was described[3] in 1916. In this operation, a horizontal incision in the conjunctiva and Tenon's capsule exposes the muscle tendon with as little disturbance above and below as is possible; a suture is passed from before backward through the upper lip of this incision as far from the cornea as displacement is desired, then through the tendon backward near its insertion and near its upper border (fig. 1); the tendon is then severed from the globe, elevated, and the suture passed vertically through a narrow band of superficial sclera as far back as displacement is desired, then through the lower border of the tendon and through the lower lip of the conjunctival-capsular incision at the same distance from the cornea (fig. 2). The suture when tied includes both lips of the conjunctival-capsular incision, the receded muscle tendon, and a band of superficial sclera. Firm union of the tendon to the sclera results. This operation was planned for use on the internus in combination with advancement of the externus. For this purpose firm scleral fixation is essential. The amount of the advancement should not exceed that of the recession; otherwise undue tension on both advancement and recession sutures makes the result uncertain, with tendency to over effect. The placing of the scleral portion of the suture is not easy, and not without danger of intraocular complications. If recession alone is to be done, with no alteration of the antagonist, the scleral portion of the suture may be omitted. Then the suture can be entirely placed before the tendon is severed from the globe, an advantage in placing the suture accurately. This gives sufficiently firm attachment of the receded tendon, provided there is no injury of Tenon's capsule excepting the horizontal incision. The result is that of Beard's "curb tenotomy[1]," but more definite because of the direct suturing. If no adhesion to the sclera occurs, a true lengthening of the muscle results by addition of the capsule, rather than a displaced insertion backward on the globe. The function of the muscle then depends on its adhesion to the capsule

and the integrity of the capsule between this adhesion and the anterior segment of the globe. If there are vertical cuts or tears of the capsule this connection will be deficient.

The amount of recession permissible is limited to the distance between the natural insertion and the equator of the globe. If the tendon is set back as far as the equator there will be impairment of convergence, if beyond the equator the loss of convergence will be great and with danger of a development of divergence. Converging power should not be sacrificed even in amblyopic eyes. In experiments on rabbits Carroll and Blake[4] found adhesion of the tendon to the sclera absent or very weak in simple tenotomy, but rather firm when there was a scleral suture; with the greater local traumatism of resection they found adhesion extending a considerable distance along the sclera from the site of operation. Their results

Fig. 1 (Curdy). Suture in conjunctiva and tendon before tendon is cut.

suggest the probability that adhesion extends beyond the recession suture for some distance, varying with the amount of local traumatism.

In order to preserve converging power the recession suture should be placed as much as 2 mm. anterior to the equator. Measurements for the placing of sutures are best made from the corneal limbus, which is constant, while the position of the tendon insertion varies. The distance from the corneal limbus to the equator being 12 mm. and the position of the tendon insertion varying between 5.5 and 7.5 mm. from the limbus, only 3 or 4 mm. remain available for recession. Recession, whether alone or combined with advancement, can be used safely for only moderate degrees of squint; used alone the effect is often less than the measured displacement; combined with equal advancement the effect is the full amount of the recession with some tendency to over effect, probably due to excess of the advancement. The function of the advancement is only to insure full effect of the recession, not to

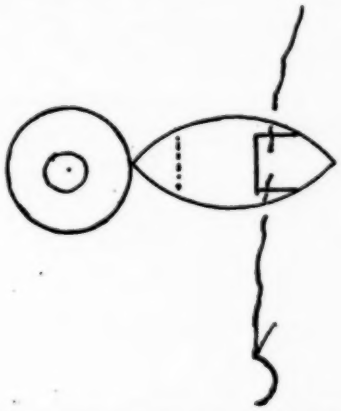


Fig. 2 (Curdy). Suture in place after tendon is cut.

increase it. If greater effect is needed the advancement should be delayed until the recession has healed thoroughly and its effect has been established. Then advancement can be done as in the primary operation. Burch and Grant[5] advise, in the combined operation, a greater amount of shortening (tucking) than of recession, but this violates the old surgical principle that sutures should not be under tension. The fault of simple advancement is the uncertain amount of yielding due to tension on the sutures; in the combined operation the yielding is at the expense of the receded tendon since the recession suture cannot be as firmly anchored as the advancement or tucking sutures. The shortening can be even less than the recession and still perform its function of insuring the effect of the recession.

In recent years the recession operation has been brought to notice by several writers, especially Jameson[6], Berens, Losey and Connolly[7], and Peter[8]. Variations in the placing of sutures are

described by Agatston[9], Lombardo[10], and Mott[11]. All use the vertical conjunctival incision, the bridle type of suture, and a complication of sutures and of their placement apparently adopted from the requirements of the advancement operation. If recession alone is done, or combined with shortening of no greater extent, simpler suturing is sufficient and involves less traumatism. The sutures are not subjected to tension, especially the high tension of the advancement operation. Wilkinson[12] uses the simple, direct scleral suture, but with a vertical incision of conjunctiva and capsule. Jackson[2] advised the horizontal conjunctival incision because "this radiating incision is less likely to divide large vessels passing forward toward the corneal margin, and there is much less gaping of the incision, less danger of sinking of the caruncle, and no need to introduce a stitch to prevent this unpleasant result." The horizontal incision has been adopted only by Lancaster[13], who uses it in his advancement operation. To Jackson's reasons he adds, "The chief advantage is in the cosmetic effect. With the commoner more or less transverse incision, there is too often an ugly blemish, lasting for weeks or even months, where the conjunctiva covering the site of operation is thickened, hyperemic and somewhat puckered, in marked contrast to the smooth adjoining conjunctiva. Sometimes this blemish is visible for years and may never disappear. It is, therefore, an important consideration. This blemish is not an inevitable consequence of the various transverse incisions or flaps. It is, however, much more difficult to secure a satisfactory, smooth and good looking scar with that form of incision." It can be added further that the horizontal incision permits operation with less traumatism to all of the structures involved. Berens[14] has found stitch infections and disfiguring scars resulting from the Reese resection operation, attributed by him to the fact that the conjunctival incision is directly over the position of the resection sutures. He avoids these complications by making the conjunctival incision posterior to the site of the resection, as near the canthus as possible.

Recession is useful only in convergent squint. Divergent squint being due to insufficiency of the interni can be corrected only by shortening these muscles; simple tenotomy of the externus has little effect, and if combined with shortening of the internus there is no danger of excess of effect unless the shortening is excessive. Recession can be used safely to correct only low degrees of squint, not more than 20 degrees. Used alone the final effect is sometimes less than the measured displacement. There is no danger of over effect, the great fault of simple tenotomy. When combined with shortening of the externus by advancement, tucking, or resection the effect is the full amount of the recession; over effect of uncertain amount will sometimes occur if the shortening is more, even a little more, than the recession.

Of all the muscle operations, simple tenotomy is superior in all respects excepting the important one of control of effect. It is easy to perform, involves slight traumatism and short convalescence, heals smoothly and with an imperceptible scar; there is little danger of unpleasant complications. The purpose of the recession sutures is to supply control of effect and at the same time to preserve the great advantages of simple tenotomy. This can be done in the highest degree by using the simplest methods of suturing.

Questions of diagnosis of the types of squint, of indications for operation, and of the relative faults of the muscles involved are outside the purpose of this paper. As indicating the limitations of recession, it is to be noted that the internus is the dominating motor muscle, with the greatest capacity for producing as well as for compensating errors of motility, and is the muscle usually at fault in lateral squint through excess or deficiency of function. Treatment is to be planned primarily to give normal function to the internus; any operation on the externus is secondary, and only to supplement that of the internus.

1409 Bryant Building.

References

[1] Beard, C. H. Ophthalmic Surgery. Ed. 2, 1914, pp. 193-194.
[2] Jackson, E. Wood's System of Ophthalmic Operations. 1911, pp. 685-735-737-739.
[3] Curdy, R. J. Jour. Missouri Med. Assoc. 1916, v. 13, p. 16.
[4] Carroll, F. D., and Blake, E. M. Arch. of Ophth., 1932, v. 8, p. 711.
[5] Burch, F. E., and Grant, H. W. Trans. Amer. Acad. Ophth., 1930, p. 63. Amer. Jour. Ophth., 1931, v. 14, p. 489.
[6] Jameson, P. C. Trans. Amer. Ophth. Soc., 1922, p. 166. Arch. of Ophth., 1931, v. 6, p. 329.
[7] Berens, C., Losey, R. R., and Connolly, P. T. Amer. Jour. Ophth., 1929, v. 12, p. 720.
[8] Peter, L. C. Arch. of Ophth. (abstr.) 1932, v. 7, p. 815. Amer. Jour. Ophth. (abstr.) 1932, v. 15, p. 962.
[9] Agatston, S. A. Amer. Jour. Ophth., 1931, v. 14, p. 1144.
[10] Lombardo, M. Amer. Jour. Ophth., 1932, v. 15, p. 523.
[11] Mott, W. C. Arch. of Ophth., 1932, v. 8, p. 858.
[12] Wilkinson, O. Strabismus. 1927, p. 211.
[13] Lancaster, W. B. Trans. Amer. Acad. Ophth., 1917, p. 122.
[14] Berens, C. Trans. Sec. Ophth. A.M.A., 1932. Arch. of Ophth., 1932, v. 8, p. 321.

A CASE OF MELANOTIC SARCOMA OF THE IRIS

SAMUEL J. MEYER, M.D., F.A.C.S.
CHICAGO, ILLINOIS
AND
DOZ. J. KUBIK
PRAGUE, CZECHOSLOVAKIA

This is an example of iritic tumor, which, suspected of being sarcomatous, was removed when enucleation was refused. In its later course it involved the whole anterior portion of the globe and enucleation was finally permitted because of the pain. The dissemination of pigment in the anterior chamber should be regarded as indicative of malignant melanotic tumor and enucleation strongly advised. From the German University Eye Clinic, Prague, Prof. Dr. A. Elschnig, Director.

The following case presents an interesting contribution regarding the question of the operative removal of intraocular tumors from an eye with preservation of visual acuity.

In a 54-year-old man, who came from a myopic family, there was accidentally discovered during a refraction in May, 1922, a tumor of the upper half of the iris of the left eye, which had converged since childhood. The visual acuity of each eye with a —12.00 diopter sphere was 6/36. Definite atrophic choroidal areas were present in the macular regions. In the left eye, the episcleral veins in the upper half were markedly dilated and tortuous, the remaining bulbar vessels being normal. The posterior surface of the cornea was covered with considerable fine pigment, which, after the manner of precipitates in chronic iritis, was more dense in the lower part of the cornea than above. On account of the myopia the anterior chamber was very deep; the iris, definitely hyperemic over its entire surface in contrast to that of the normal eye, was of a bluish-green color, markedly rich in pigment, with many, fine, dark gray naevi over its entire surface, such as may appear on the iris of the normal eye (spotted iris). In its upper half there was a globular growth, reddish-brown in color, the size of a pea. The iritic tissue on the nasal border of the tumor was darkly pigmented. Two parts could be differentiated in the new growth itself, which was covered with dilated capillaries and had a warty surface.

This reddish-brown, globular tumor mass lay against the pupillary border, forming a markedly pigmented brownish-black cap corresponding to the pigment layer of the iris and apparently without vascularization. The normal iritic tissue was sharply differentiated from the tumor. The iris was replaced

by the tumor, for the latter was not pedunculated, but projected downward over the border of the moderately dilated pupil, its position unaffected by the movements of the iris. The shape of the pupil constantly changed, because when dilated the pupil was kidney-shaped, and when contracted, it was pear-shaped because the tumor lagged behind. The reddish-brown tumor mass extended anteriorly, in places, as far as the posterior corneal surface. It disappeared in the anterior chamber without any sharp border. The light bluish-green iris could be readily transilluminated by the Sachs lamp; only the tumor produced a dark shadow. The adjacent ciliary body could not be differentiated from the remaining ciliary body by transillumination. From this last observation it could be determined that the tumor was confined to the iris and iris root and had not involved the ciliary body to any extent. The deeper eye segments did not reveal any pathological changes other than the myopic fundus changes. The tension was 36 mm. Hg in contrast to 12 mm. Hg in the normal eye.

From the preceding picture there was no question as to the diagnosis of iritic tumor, probably of a sarcomatous nature. In view of the fact that the patient positively refused enucleation as advised, even after the dangers were pointed out that an eventual operative removal of the tumor might have upon his eye and even his life, Prof. Elschnig decided upon the operative removal of the iritic tumor following his technic, as published by Raubitschek and Waldstein during their time at the Elschnig clinic. Following the preparation of a conjunctival flap tied from above, an incision with a scalpel was made from the outside, somewhat peripheral to the limbus, extending through the width of a corneal section, similar to that made in a cataract extraction. The iris was then grasped medial to the tumor with a dull hook, pulled forward, and incised as far laterally as possible into the healthy iris tissue. The tumor was removed through the retracted wound and excised with the parts of the ciliary body within reach. The wound healed normally, and the patient was dismissed on the seventh day for ambulatory treatment.

The histological examination of the tumor disclosed pigmented cells, the morphological character of which could not be definitely determined, but which probably belonged in the sphere of the sarcomata.

The operation was followed by three x-ray exposures to the left eye, after the custom in those days, when such poor results were so often produced by roentgen therapy.

The eye remained completely free from irritation during the following months, while the general condition of the patient was good. One-half year after the operation there was noticed for the first time a marked, fine granular pigmentation, of a brownish-black color in the conjunctiva, which was interpreted as a local recurrence. Enucleation was again advised, but the patient still refused, so that Prof. Elschnig excised the locally diseased part of conjunctiva, and covered the defect with healthy conjunctiva. After the removal of the pigmented conjunctiva, nothing of a suspicious character could be seen on the sclera macroscopically. In the excised piece of conjunctiva were found many thick, isolated clumps of globular-like tumor areas up to 1 mm. in diameter, which were mostly of a typical epithelial character, interspersed in part with dark pigment, and many flattened, highly pigmented cells between the unstained cells. The pathological anatomy indicated a "non-specific melanotic tumor," while Prof. Kreibich of the Dermatological Clinic believed it to be a highly malignant melanocarcinoma.

Following the conjunctival excision which was done in October, 1923, two new roentgen exposures were made. The patient then remained away from the clinic for nearly two years. He was again examined in March of 1925. The iris and posterior corneal surface throughout the extent of the entire anterior chamber revealed an accumulation of brownish-black pigment, not of a tumor like character, but like a thick pigmentation, the remaining iris being thickly covered by finely pigmented

precipitates, with still an apparently normal pupillary reaction and normal tension.

The general physical condition of the patient was now definitely changed. He was markedly thinner, definitely restless, nervous and unable to sleep. The urine did not contain any melanin or melanogen. During the following weeks a sciatica developed, which did not respond to the usual sciatic therapy. It was impossible to carry out an accurate examination upon the excited nervous patient.

He was again examined in February, 1926, at which time marked changes in the eye had occurred. These constituted a definite picture of uncompensated glaucoma, with new pigmentation in the conjunctival scar above the limbus and nasally in the palpebral-fissure region, a circular naevus-like focus in the conjunctiva, and on the posterior surface of the cornea so thick a covering of pigment masses that it was very difficult to look into it. The iris was now so thickly pigmented that it was practically impossible to differentiate the former striped markings. X-ray examination at this time revealed the cause of the sciatica, for a spinal tumor was found on the lumbar border of the dorsal vertebrae. The visual acuity was reduced to 1/60. The patient now for the first time consented to enucleation because of the severe pain, and this was performed in March, 1926. He died several months later from symptoms of paralysis. As the death did not occur in a hospital, no post-mortem examination was made. There is no doubt, that in spite of the negative result of the melanin and melanogen examination, there had been metastases into the internal organs for a long time.

The eyeball was divided into an anterior and posterior portion by means of a frontal equatorial incision; both portions sectioned serially, vertically, from which every tenth section was stained by the usual staining methods. Several sections of the anterior bulbar portion were depigmented with hydrogen peroxide or potassium permanganate and oxalic acid.

The posterior bulbar portion did not reveal changes of any importance except for the characteristic findings of a high-grade myopia, and above all, practically no pigment deposits either in the vitreous or along the vessels in the vicinity of the tunics of the eye.

The sections through the scar in the region of the limbus revealed a definitely discernible bridge of predominant pigmentation, with isolated unpigmented tumor cells, definitely associated with the tumor masses (to be

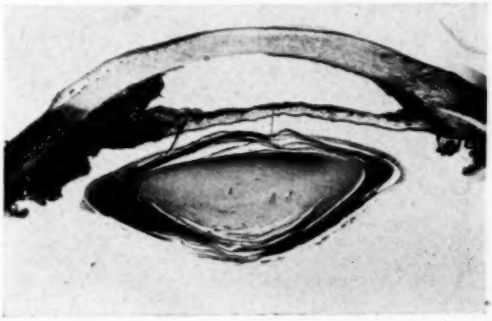


Fig. 1 (Meyer and Kubik). The chamber angle at the left reveals the infiltration of the ciliary body and iris by the tumor cells.

mentioned later) in the chamber angle and the isolated predominantly pigmented tumor colonies situated in the conjunctiva. The iris on each side of the former coloboma was three-to-four times its previous thickness, the thickening being imbedded with dark-brown-to-black pigmented cell masses, in which was found a scanty vascularization. Towards the central part of the iris were small islands of unpigmented tumor cells rather conspicuously accumulated in the otherwise black pigmented masses in a manner similar to those found as free implantations in the region of the zonular fibers and on the anterior and posterior surfaces of the lens. Towards the anterior chamber the iris had an uneven surface, tumor masses in the anterior surface of the iris being its anatomic foundation. On the anterior surface of the iris itself were situated, here and there, partly pigmented and partly unpigmented tumor islands.

The chamber was filled throughout its extent by a section of a triangular-

appearing, dark-brown, pigmented mass, walling-in the ligamentum pectinatum and its connection with the chamber angle. The vascularization in the region of these tumor masses was likewise very sparse. From this massive tumor formation at the chamber angle, extensions spread over the entire posterior surface of the cornea, which later

Fig. 2 (Meyer and Kubik). Infiltration of the ciliary body and iris by the tumor cells.

became disorganized into loosely lying, partly pigmented, partly unpigmented tumor islands. Its character may best be understood by the term "tumor precipitates." These tumor-mass precipitates, partly pigmented, partly unpigmented, were also present on the anterior lens surface. On the posterior surface of the iris and the anterior lens surface likewise ran long grooves of partly pigmented, partly unpigmented tumor masses. The ciliary body musculature was very poorly developed on account of the high-grade myopia, which leads one to believe that the rarefaction of the musculature was more pronounced than the myopia could account for. No sign of tumor implantation in the muscular parts of the ciliary body could be seen. The very sparse and very flat ciliary-body appendages, particularly in so far as they lay posteriorly, were tumor free, while those extending farther forwards, and likewise the lower ciliary-body appendages, here and there contained clumps of pigmented, as well as unpigmented tumor colonies. Entire paths of tumor cells extended out from these islands, partly single, partly in groups of 5-8 cells lying together, spread out at full length towards the lens equator in the direction of the zonular fibers, while similar tumor colonies could be seen on the posterior lens surface, giving the impression that the zonular fibers were the course along which the tumor spread. The posterior surface of the lens up to the posterior lens pole contained such stratifications of either single cells or groups of cells, which can be best characterized as lens precipitates. The lens also was covered with tumor precipitates throughout its entire extent, on the anterior surface as well as the posterior side. The variation of the pigment content was conspicuous in that there obviously appeared the same kind of cells, here pigmented, there unpigmented. The islands lying scattered on the posterior corneal surface, on the iris surface, in the region of the zonular

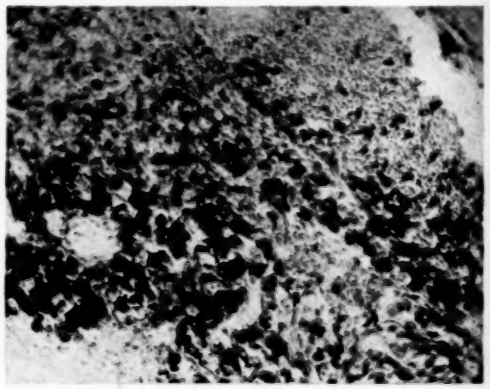


Fig. 3 (Meyer and Kubik). A depigmented area of the iris showing the characteristics of the tumor cells.

fibers, and on the anterior and posterior lens surfaces were always free from blood vessels. These facts remind one of a case of metastatic tumor of the iris published by Hermann Elschnig, in which the source of the tumor masses not in connection with the tumor were present without any vascularization. The vitreous itself was free.

The anatomical picture completely explains the clinical course. It is surprising that the complete blocking of the chamber angle led to a severe glaucoma only in the last few weeks before the enucleation. A small fistula situated in the region of the corneal scar near its center at "12 o'clock," naturally explains the reason why the glaucoma did not develop so early. The inner orifice of this fistula evidently first became closed by the rapidly spreading tumor masses only in the last few weeks.

The present case is new proof for the correctness of the idea that enucleation must be prescribed in cases of definite intraocular tumors. Only when this is refused, can one think of removing the tumor with preservation of the eyeball, the patient being warned of the risk of such an operation. As the x-ray treatment of intraocular tumors up to the present time has been unsuccessful, the operative removal of a tumor is certainly indicated in those cases in which enucleation is refused in spite of our advice. It is nevertheless possible that even in our case death was at least postponed by the removal of the tumor. It should not be forgotten, that under certain circumstances, a radical removal of an intraocular tumor may be successful, as Hirschberg's case reveals, in which the patient remained well for ten years after the tumor removal and then died of an intercurrent disease. Even though there is a possibility of a radical operative cure, it is the duty of the surgeon to insist upon the enucleation of an eye when an intraocular tumor is present.

The diagnosis of an iris tumor cannot be definitely made clinically. We refer here to the four cases published by E. Waldstein and by Raubitschek from the Elschnig Clinic. The iris tumor of the first case was diagnosed as an endothelioma, which may be classified as a "neurocystoma" under the present classification of tumors. In the second case also the tumor could not be definitely classified, but should belong in the same category as the first case. The third case (the second case of Raubitschek) involved a granulation growth of an unknown origin, and also the fourth case, which gave the clinical impression of an unquestioned tumor. In such cases, in which recurrences were not present, it is justifiable to extirpate the iris tumor and retain the eye.

It is of the utmost importance to differentiate the malignant iris tumors from the so-called benign, also from the rare pigment cysts of the posterior iris lamella, by the dissemination of pigment in the area of the entire anterior chamber. On the basis of our present experiences we should designate an iris tumor as an unconditional malignant melanotic tumor when the dissemination of pigment in the anterior chamber is present after a short interval, and should recommend enucleation.

58 E. Washington Street.

References

Waldstein, E. Zur Kasuistik der Iristumoren. Klin. Monatsbl. f. Augenh., 1910, v. 48, p. 313.

Raubitschek, E. Ueber Iristumoren. Klin. Monatsbl. f. Augenh., 1914, v. 52, p. 683.

Elschnig, H. H. Metastatisches Aderhautsarkom. Arch. f. Ophth., 1926, v. 117, p. 316.

LINEAR MEASUREMENT OF STRABISMUS

A new, simple, and accurate method

J. GARFIELD ALCORN, M.D.
COLUMBUS, OHIO

The method outlined below and the instrument described is the first device known to me which has been given for the accurate estimation of strabismus by linear measurement and, what is more important, for the absolutely accurate estimation of the normal interpupillary distance in the squinting patient.

These measurements are especially useful in checking results at the time of operation and also in aiding the dispensing optician in fitting the squinting patient with glasses that have the proper interpupillary distance.

The instrument can be used with the patient in the sitting or reclining position and with children after etherization preliminary to operation.

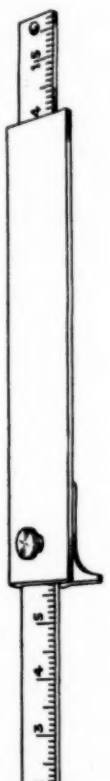
After observing many normal cases I found that the measurement of the distance from the mucocutaneous junction of the outer canthus of one eye to the mucocutaneous junction of the inner canthus of the other, exactly corresponded with the distance from the outer edge of one pupil to the inner edge of the other.

If one does not feel sure of the measurement he can check it in the following manner: Take the measurement from the mucocutaneous junction of the outer canthus of one eye to that of the outer canthus of the other eye and add to this the distance from the mucocutaneous junction of the inner canthus of one to that of the inner canthus of the other eye and divide by two.

This result should exactly correspond with the first measurement and should it not do so a mistake has been made and all the measurements should be taken again.

The instrument is simply one of the pupillometers on the market with the addition of a set screw that makes the measurement permanent.

In squint surgery most satisfactory work is accomplished, I believe, by advancement or tendon tucking of the weaker muscle and recession of the other. After shortening one muscle and inserting sutures in the other it is an easy matter, by tightening or loosening the sutures that are inserted in the muscle undergoing recession, to "set" the pupils to what should be the normal interpupillary distance with the use of this instrument.



STRABISMOMETER

287 East Town Street.

NOTES, CASES, INSTRUMENTS

TUBERCULOUS SCLEROKERATITIS

Cured by pericorneal transplantation of buccal mucous membrane*

RUDOLF DENIG, M.D.
NEW YORK

The cornea contains neither blood vessels nor lymph vessels and depends for nutrition entirely upon the small amount of fluid that filtrates from the limbus into its parenchyma. Accordingly, metabolism is slow and effected by fine convolutions of capillaries located at the boundary line between cornea and sclera which get their supply partly from conjunctival and partly from ciliary vessels.

This peculiar method of nutrition, due to the necessity of transparency, deprives the cornea, to a considerable degree, of immunization found in other parts of the body and isolates it biologically. In tuberculous infections of the cornea, the specific immunity attained by the rest of the body, cannot exert much influence unless there is an increase of vascularization. The difficult access to immune bodies by the sclerocorneal tissue explains also the fact that specific treatment with tuberculin very often does not give much satisfaction.

Schieck dwells, in his latest book on "Tuberculous infection of the eye," on this peculiar biological isolation of the cornea. He states that tuberculin as such seems to be of little value in fighting the tubercle bacillus, except for its ability to produce around the focus of infection dilatation of the bloodvessels.

In explaining the rationale of a transplanted graft I have always laid stress on its hyperemic effect which, in causing an increase of fluid filtrating into the corneal tissue allows an increased nutrition and, according to Schieck, immunization. To this are to be attributed the many good results which I obtained not only in cases of pannus or burns, but also of torpid, dystrophic and herpetic processes and especially of sclerokeratitis. In one case of sclerokeratitis a man suffering for weeks from a tonguelike infiltration of the cornea improved rapidly after transplantation of buccal mucous membrane at the corresponding limbar region. The patient was ready to leave the hospital on the twelfth day after operation when two new infiltrations appeared on the opposite side of the cornea. These were likewise treated by transplantation and similarly cured within two weeks.

A man of 36 years of age, seen recently, shows in a striking way, in one and the same eye, the results obtained by the conservative treatment and those by transplantation. I saw him first in May, 1929, when he was suffering from sclerokeratitis which had originated two weeks previously from the lower limbus. The Mantoux test, being negative in the beginning, became very strongly positive later. Transplantation was proposed but declined by the patient. Tuberculin treatment and x-rays were given, but not until April, 1931, did the inflammatory process decrease, leaving however, multiple scars on the cornea. Needless to say, every attention was paid to the general condition as well as to teeth, tonsils and sinuses. About the middle of January, 1932, a tonguelike infiltration began again to invade the cornea, this time from the upper limbus, whereupon I decided upon immediate transplantation. At the limbar region, adjoining the full length of the sclerokeratitic process, the conjunctiva was excised and a graft of buccal mucous membrane, about 8 mm. wide was implanted. The operation was performed by my associate, Dr. John J. Reid, Jr., on January 21, 1932. Within two weeks after the operation the infiltration disappeared and the inflammation ceased.

56 East 58th street.

* Read before the Section on Ophthalmology, New York Academy of Medicine, January 16, 1933.

References

Denig, R. Transplantation of the mucous membrane of the mouth for various diseases and burns of the cornea. N. Y. Medical Journal, 1918, June 8.

———. Early surgical treatment of burns of the conjunctiva. Amer. Jour. Ophth., 1920, v. 3, no. 4, p. 258.

———. Circumcorneal transplantation of buccal mucous membrane as a curative measure in diseases of the eye. Arch. of Ophth., 1929, v. 1, p. 351.

———. General remarks on transplantation etc. Arch. f. Augenh., 1932, v. 105, pp. 726-730.

Schieck, F. Tuberkuloese Infektion und Augenleiden. Leipzig, Verlag von Johann Ambrosius Barth, 1932.

LARGE RETENTION CYST OF CONJUNCTIVA

R. O. Ebert, M.D.
OSHKOSH, WISCONSIN

In a review of the literature on cysts of the conjunctiva, one finds a paucity of reports and the cases cited are mostly of multiple, small cysts.

One of the first papers on the subject is that of Stoewer[1] in which is reported a cyst of the fornix. This author believes that these cysts definitely have their origin in the glands of Krause. Alt[2] enumerates the types of cysts according to etiology: glandular; lymphatic; inclusion following surgery; and entozoon, of which none have been reported in the United States. Alt saw four conjunctival cysts in thirty years of practice. He has suggested that cysts in the fornices are mostly glandular (Krause's or Henle's), probably follow inflammation, and have linings of cells several layers thick. Cysts of the bulbar conjunctiva are usually from lymph vessels, and have linings of one or two layers of flat endothelial cells.

The largest cysts reported are those of Capolongo[3] and Butler.[4] The one of Butler (entozoon) measured 1.75 x 2.5 cm.

J. S., aged nine years, was seen April 3, 1931, because of a large growth in the left eyelid. His mother noticed the growth during approximately the past year, before consulting an oculist, and believed it to be increasing in size rapidly. A photograph taken when the child was a baby, showed the left lower eyelid bulging forward slightly. A large structure, 16 x 25 mm., apparently a retention cyst, was found present in the lower fornix of the left eye, extending almost from the limbus above, to the lid margin below. The cyst was removed November 28, 1931, preserving the very thin conjunctival covering. There has been no recurrence

and a good plastic result was obtained. Sections of the tissue showed a single layer of cuboidal cells lining the cyst.

References

[1] Stoewer. Klin. Monatsbl. f. Augenh., 1897, v. 35, pp. 234-239.

[2] Alt. Amer. Jour. Ophth., 1908, v. 25, pp. 292-294.

[3] Capolongo. Ann. Di Ottal., Pavia, 1904, v. 33, pp. 393-402.

[4] Butler. Ophthalmoscope, London, 1907, p. 706.

LIPOMA OF THE ORBIT

Report of a case

Ambrose Earl Edgerton, M.D., and W. P. Stowe, M.D.
SAN FRANCISCO

There are many types of tumors that arise from the orbit, but lipoma of the orbit is rare, and the literature is scant concerning it. This type of tumor is usually symmetrical, grows slowly, and when removed does not recur.

Collins and Mayou[1] refer to masses of orbital fat, which are really hernia-like projections of fat which bulge forward under the lid due to a congenital deficiency in Tenon's capsule and are often associated with dermoid growths

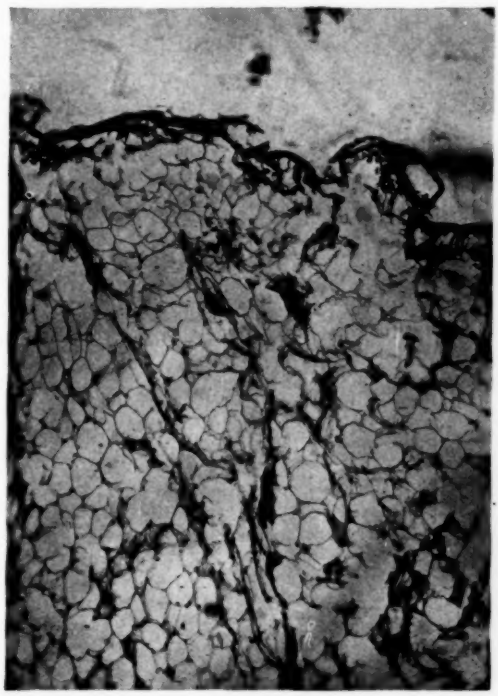
and coloboma of the eyelids. However, the case here described was encapsulated and was adherent to the inferior rectus muscle.

The patient was a white male of sixty-two years, who came to the office complaining of a growth under the lower left lid, which he had noticed for the past six months. It had gradually increased in size and often the lower lid would drop below the mass and it was only with the greatest difficulty that the lid could again be raised over the growth.

His family history was irrelevant. He was a baker by trade and except for occasional colds had always enjoyed good health. There was no history of injury or operations. The general physical examination did not reveal any pathology except that he was overweight. His blood pressure was normal and the Wassermann, urine, and blood tests were essentially negative. Cultures and smears from the conjunctiva showed a few gram-negative bacilli to be present.

When first seen there was some conjunctival redness below the cornea in the left eye. The palpebral fissure on this side seemed to be somewhat larger than its fellow and the lower left lid seemed swollen and protruded in the midline. There was no edema nor discoloration of the skin. The tear sacs were normal. On everting the lower left lid, a large mass popped into view which held the lower lid below the growth. The tumor mass was readily movable and was not attached to the conjunctiva. The growth was smooth, pink in color, and extended into the orbit below the eye. It was quite firm to pressure, painless, and had about the consistence of a lipoma. It was not cystic nor nodular. Its longest diameter was in the horizontal meridian, extending for a distance of 1-½ centimeters directly below the cornea and was one-half centimeter in thickness. The eyeball appeared to be somewhat raised but there was no diplopia or muscle imbalance. The vision in each eye was 6/6 with correction. The tension was normal and the rotations were full and free in all directions. The pupils were 2-½ mm. in diameter, round and equal, and reacted normally to light, accommodation, and consensually. The cornea of each eye was clear and the anterior chambers were of normal depth. The ophthalmoscopic examination of each eye did not reveal any pathology, except that the retinal vessels showed evidence of sclerosis.

A tentative diagnosis of orbital lipoma was made and the patient was admitted to the hospital for operation. The growth was removed under local anesthesia. Recovery was uneventful. The mass was larger than expected and extended deeper into the orbit than was originally thought.



Microscopic section of orbital lipoma (Edgerton and Stowe).

Dr. Stowe of St. Luke's Hospital examined the specimen and gave the following report: The gross specimen measured 12 by 5 mm. The surface was smooth and of a pale gray color. The mass was encapsulated, soft, and of about the consistence of a lipoma. Microscopically, the sections were those of a lipoma with rather small fat spaces,

having adult-type fat cells without excess of cellularity, and a few fibrous-tissue bands. Some muscle fibers were noted at one edge. There were no signs of inflammation or sebaceous glands, nor was there evidence of malignancy. The mass was completely encapsulated by a fibrous tissue band except at the base where it was attached to the muscle. Diagnosis—lipoma of the orbit.

There has been some discussion in the past as to whether lipoma of the orbit ever really occurred. Dermoid cysts and dermo-lipomata too have at times been mistaken for fatty tumors. However, Knapp[2] and Puccioni[3] have described cases of orbital lipoma and Parsons[4] states that the occurrence of simple lipoma cannot be eliminated.

References

[1] Collins and Mayou. Pathology and bacteriology of the eye. p. 136.
[2] Knapp. Quoted by Parsons. v. 2, 1904, p. 727.
[3] Puccioni. Quoted by Parsons. v. 2, 1904, p. 727.
[4] Parsons. The pathology of the eye. v. 1, 1904, p. 137.

A CROSS CYLINDER FOR DETERMINING AXIS

D. P. HORNBOGEN, M.D., F.A.C.S.
MARQUETTE, MICHIGAN

The instrument here presented differs from the usual cross cylinder in that it is placed in the trial frame and is not held by the hand of the refractionist. This offers distinct advantages in checking the axis although the hand type is more convenient for determining strength.

It consists of an outer ring analogous to the trial case ring into which is fitted a second ring containing the cross cylinder. There are two stops on the outer ring, which allow the inner one to be rotated through an arc of exactly 90 degrees. The outer ring is marked midway between the two stops and when the instrument is placed in the trial frame this is placed so that it coincides with the axis of the test lens. By means of a small handle on the inner ring the cross cylinder can be rapidly rotated so that its axes are exactly 45 degrees to either side of the axis of the test lens. The lens used is a plus .25 diopter minus .25 diopter cross cylinder, so marked that the plus and minus axes are easily distinguishable.

Once placed in the trial frame the only operation necessary is the rotation

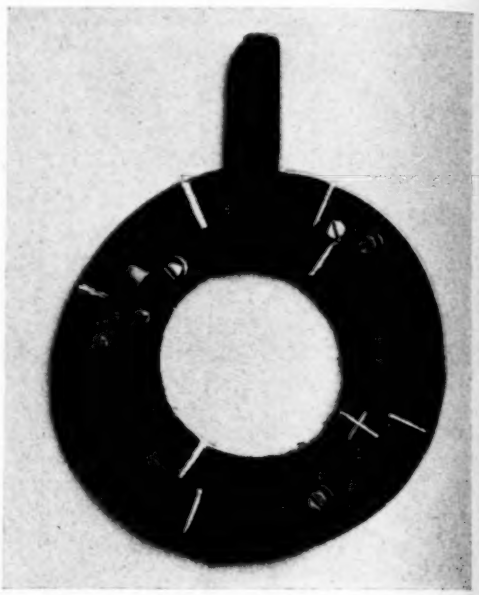


Fig. 1 (Hornbogen). Cross cylinder for determining axis.

of the inner ring through the exact arc of ninety degrees. The outer ring moves with any change in the position of the test lens so that the relation of the two is always correct whereas in the hand type it is impossible to be sure that it is not held several degrees out of position. This naturally brings about the selection of a more accurate axis and is much less tiring to the arm of the refractionist.

The writer has been using this instrument for a number of months and is firmly convinced of its superiority over the usual methods. Like any other cross cylinder its greatest value is in determining the axis of cylinders of weak or moderate strength.

401 Savings Bank Building.

SOCIETY PROCEEDINGS

Edited by Dr. H. Rommel Hildreth

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

November 15, 1932

Dr. David M. Wells presiding

Lattice keratitis

Dr. Paul Chandler presented a young woman, aged 25 years, whose vision for the past six months had been somewhat blurred. The vision was improved in the right eye with a —4.00 cylinder to 6/12—, and in the left eye to 6/9— with a —4.00 cylinder. The eyes were white and quiet. With the loupe, it could be seen that in places the corneal reflex was slightly irregular. With the ophthalmoscope held at a distance, all but the very periphery of the cornea in each eye was seen to be filled with fine dots and lines. The media were otherwise clear, and the fundi normal. With the slitlamp these opacities were seen to consist of fine lines and irregular small whitish spots. They were situated chiefly about the depth of Bowman's membrane, but in some places, extended to two-thirds the thickness of the cornea.

Discussion. Dr. Allen Greenwood said that in cases of his own he had noticed that the punctate spots were more prevalent than the radiating lines and, in one case, went very deep, nearly touching Descemet's membrane. Dr. Hughes of New York had found that in these cases the hemoglobin was usually low, as was the blood count. Blood transfusions had been tried and the condition greatly improved; but, in spite of treatment, the patients usually became blind.

Pemphigus of the tarsal conjunctiva

Dr. M. J. King prsented a patient who first came to the Infirmary on September 12, 1932, complaining of irritation of both eyes. He gave a history of having been to the Portland Eye and Ear Infirmary in July for a Vincent's infection of the throat, but stated that at that time there was some inflammation in his eyes for which he received eye drops. The irritation in the eyes had increased during the past few weeks, and upon everting the lids himself, he had noticed peculiar reddish places.

Upon the day of admission the right eye showed slight congestion of both conjunctival fornices, with a marked constriction of the lower fornix and extensive scarring especially of the upper tarsal conjunctiva. There were three tabs of granulation tissue protruding from crater-like depressions. In the upper fornix of the left eye there were three deeply punched-out crater-like depressions with several similar depressions in the lower lid. There was a constriction of the lower fornix and scarring with definite symblepharon formation in both eyes. Three tabs of granulation tissue were removed from the upper lid of the left eye, in addition to four from the right eye. This tissue was examined bacteriologically and histologically, and animal inoculations were made. The section showed granulation tissue with an infilammatory reaction, and an infiltration of eosinophiles suggesting pemphigus. The animal inoculations and cultural studies were all negative. Blood was sent to Dr. Pels of Johns Hopkins Medical School who reported a toxic reaction of —55 percent, confirming the clinical diagnosis.

The patient had been completely studied and no evidence of pemphigus elsewhere in the body was found, although on one occasion there was a faint trace of albumin in the urine, but no hematuria.

Spontaneous vitreous hemorrhage

Dr. J. M. Levitt presented a young man, aged 19 years, who had been first seen on October 28, 1932, complaining that on the previous day things seemed

greenish to him as he came out of a moving picture theatre in the afternoon; in the evening of the same day his vision in the left eye was blurred, and on the following morning vision in that eye was entirely lost except in the lower field. There was no history of trauma or of any previous ocular disturbance. Vision had always been good in both eyes, and he had never worn correcting lenses.

The right eye was normal with vision of 20/20; the vision of the left eye was limited to counting fingers at three feet in the lower field. The posterior vitreous of the left eye was filled with bright red fresh blood, obscuring the fundus except for the upper periphery where a few scattered pigment spots were noted. Transillumination was negative. The blood in the vitreous rapidly absorbed with recovery of vision to 20/20 on the twelfth day. The fundus pathology gradually became evident. There were a few superficial linear hemorrhages above the disc and a large retinal hemorrhage covering the disc below and temporally overlying the inferior vessels and extending in a narrow band temporally. In addition to the few isolated pigment spots, there was a large focus of pigment deposition in the temporal periphery. Just temporal to this cone, and about at the limit of ophthalmoscopic observation, there was a mass of bluish-white preretinal proliferative tissue surrounded by bright red vitreous blood and a similar area was noted in the lower temporal periphery. The disc was normal, and the macular region was not affected; the retinal blood vessels were normal except for definite tortuosity of the temporal peripheral veins.

There was a definite familial history of lues and the mother received antiluetic treatment during intra-uterine life of the patient. There was no family history of tuberculosis.

The patient had had four nosebleeds one year ago within a period of two weeks. There was no history of constipation, headache, fatigue, depression or loss of weight. He had a tonsillectomy five years ago; right herniorrhaphy four years ago; an appendectomy two years ago, without indication of any hemorrhagic tendency. He had received several courses of antiluetic treatment within the last four years.

General clinical examination and laboratory studies revealed the patient to be in good condition without evidence of tuberculosis, blood dyscrasia, endocrine disorder, or neuro-syphilis, and without any of the gross stigmata of hereditary lues. The blood Wassermann was strongly positive and there was a marked positive reaction to 1/30,000 milligrams of old tuberculin.

Discussion. Dr. W. H. Lowell remarked that he had been treating a patient with small doses of arsenic which had held the condition in check.

Dr. F. H. Verhoeff said the many old isolated pigment spots indicated that the patient had had a definite syphilitic lesion of which he had never been aware. These might have been evidence of an old chorioretinitis.

Dr. A. Greenwood asked whether congenital syphilis had anything to do with the condition. In spite of pigment spots, he did not think that syphilis was at the root of the eye trouble.

James J. Regan,
Recorder.

ST. LOUIS OPHTHALMIC SOCIETY

January 27, 1933

Dr. M. W. Jacobs, president

Plastic operation for ectropion

Dr. Lawrence Post showed a white, male patient, aged sixty years, who had had the left eye enucleated with a glass ball implant following a lacerating wound of the cornea and sclera. Extreme ectropion of the lower lid prevented the wearing of an artificial eye. Dr. Post performed a plastic operation, using a fascia lata transplant to act as a sling support. This began at the external orbital ridge and followed close to the lower lid margin to the external canthus under the skin. The cosmetic result was good, and the patient was able to wear a prosthesis.

The diagnosis and etiology of trachoma in the light of recent work

Dr. Harvey J. Howard read a paper on this subject which was published in this Journal, v. 16, no. 2, p. 132.

Discussion. Dr. C. E. Rice commended highly the use of the slitlamp in the study of trachoma, as it indicated that trachoma early manifested itself in the cornea. He urged examination of the parents of school children in a community where there was a question of trachoma, along with the therapeutic test on the children. The occurrence of trachoma without pannus was exceptional but did happen.

Dr. L. A. Julianelle limited his discussion to the experimental aspects of trachoma. Work done in the Oscar Johnson Institute laboratories by Dr. Rossleene A. Hetler had led to the conclusion that a vitamin A deficiency did not influence the character or course of the disease induced in monkeys by inoculation of active human trachomatous material. There could be little reason for doubting the infectious nature of trachoma. His own experiments offered nothing to support the virus etiology. In regard to the status of Bacterium granulosis, it was not clear whether this organism possessed an inherent incapability of producing the secondary changes of trachoma, or whether the monkey was an unsuitable experimental animal. As matters now stood, Bacterium granulosis was still the strongest of all candidates as the cause of trachoma, but its case was still to be proved. To date it was the only organism capable of inducing follicles in the conjunctiva of animals. There remained to be determined the frequency of Bacterium granulosis in trachoma, the reasons for the failure to isolate it in Egypt, as well as the reasons for its inability to induce the secondary phases of trachoma in monkeys and its inactivity in the human conjunctiva when experimentally inoculated.

Monocular trachoma

Dr. John Green reported a case in a young male university student, under observation for seven years. There was scar tissue, genuine pannus and other signs of trachoma in one eye, the other eye being negative when examined by the biomicroscope. Dr. Green asked if Bacterium granulosis had ever been found in any conjunctival affection other than trachoma.

Dr. Howard in closing stated that a writer in Vienna had reported finding Bacterium granulosis in folliculosis.

Howard C. Knapp,
Editor.

ST. LOUIS OPHTHALMIC SOCIETY

February 24, 1933

Dr. M. W. Jacobs, president

Occupational diseases

Dr. Roy E. Mason presented a paper which will be published in the Journal of the Missouri State Medical Association.

Discussion. Dr. W. M. James asked if exposure to an infectious disease would be classed as an occupational disease; for example, if a person working alongside an individual having trachoma should contract the disease, would it be classed as an occupational disease? Also, in regard to carbon monoxide poisoning, did the records show a permanent loss of accommodation, or was the damage produced by carbon monoxide temporary.

Dr. J. Gross mentioned a reported case, of men working in a distillery producing wood alcohol. These men had become accustomed to wood alcohol and drank it regularly without evidence of poisoning and without injury to vision.

Dr. E. C. Spitze asked how frequently tobacco poisoning appeared as an occupational disease.

Dr. Mason (in closing) stated that in Missouri, trachoma was not considered to be an occupational disease. In regard to carbon monoxide poisoning, he said that the damage was usually temporary but that permanent macular injury had been reported. Tobacco poi-

soning as an occupational disease was extremely rare.

Howard C. Knapp,
Editor.

ST. LOUIS OPHTHALMIC SOCIETY

March 24, 1933

Dr. M. W. Jacobs, president

Metaplasia in the human eyeball

Dr. Harvey D. Lamb presented a paper on this subject.

Discussion. Dr. M. H. Post asked if the connective tissue around the retinal blood vessels might not be the source of the connective tissue seen on the inner surface of the choroid.

Dr. J. H. Gross asked whether the fibroblasts or connective tissue cells arose from the epithelial cells of the lens and of the retinal pigment epithelium.

Dr. Lamb, in reply to Dr. Post, stated that the only connective tissue in the retina was that in the walls of the blood vessels. The new-formed connective tissue was on the outer surface of the retina, whereas the retinal blood vessels were on the inner side. He did not find it possible to follow nor did he see any indication of new-formed connective tissue arising from the walls of the blood vessels in the cases reviewed. Dr. Lamb replied to Dr. Gross that the only possible explanation was that these epithelial cells became transformed into fibroblasts or connective tissue cells which later produced the connective tissue.

Howard C. Knapp,
Editor.

COLORADO OPHTHALMOLOGICAL SOCIETY

February 18, 1933

Dr. E. B. Swerdfeger presiding

Pigment granules in the anterior chamber in uveitis

Drs. William C. and William M. Bane presented S. W., a 37 year-old auto-mechanic who was first seen on December 14, 1932, with the history that following an attack of influenza in November he had noticed a dark spot in his vision on December 3rd. On December 9th, his right eye had become inflamed and painful with lacrimation, photophobia, and almost complete loss of vision. There had been no history of injury. At the initial examination there was revealed a slight circumcorneal injection with the pupil about 2.5 mm. in diameter. Posterior synechiae were present, but atropin dilated the pupil, leaving a complete ring of pigment deposit. The cornea was clear. There were granular opacities throughout the vitreous. The disc and nasal vessels were seen very indistinctly, while temporally no structures in the retina were visible. The vision was hand movement in the temporal field only. The left eye was normal with vision 5/5. A diagnosis of uveitis chiefly posterior, was made. The Wassermann reaction was negative. The teeth, tonsils, and sinuses were apparently healthy.

The patient was again seen on January 9, 1933. There was now no pain nor discomfort and vision had increased to 5/15. No fundus lesions were seen and the capsular pigment deposits were almost gone. By January 17, 1933, the vision was 5/7. The patient reported that he had noticed a little black deposit in front of the iris below the pupil. It had moved to the right and during the past two days had remained in the angle between the iris and cornea. A hand electric magnet did not budge the particle, nor did turning the head downward cause it to move.

By February 18th the patient had noticed a second dot in the lower angle of the anterior chamber at "6 o'clock," somewhat smaller than the one at the "7 o'clock" position. Dr. Edward Jackson had agreed that these dots were probably pigment which had become detached and gravitated to the lower angle. With Dr. Maurice Marcove, the spots were examined with the slitlamp and found definitely to be pigment, and minute dust-like pigment dots were seen elsewhere in this vicinity also. Vision was 5/6-1. The treatment had

consisted of large doses of salicylates and potassium iodide internally, with atropin and dionin locally.

The case was shown for three reasons. In the first place the improvement that had occurred in two months was remarkable. Secondly, the case illustrated how pigment could become loose in the anterior chamber and resemble a foreign body under ordinary magnification. Lastly, this case emphasized the extreme value of the biomicroscope.

Discussion. Dr. W. A. Sedwick asked whether these granules were apt to cause any irritation by their presence.

Dr. Edward Jackson said that he believed that they would cause no trouble because they were composed of a natural substance and would probably be absorbed. He had seen a case in a physician where the pigment from an annular synechia had absorbed entirely within a few years. He also mentioned that he had seen many pigment deposits on the anterior capsule of the lens in cases of ocular tuberculosis and believed that they occurred much more frequently than we had supposed. Dr. Jackson also said that dark colored deposits on the capsule would interfere much less with vision than light colored ones.

Dr. Maurice Marcove said that he had seen cases of pigment on the anterior capsule which interfered only slightly with vision, but on examination with the biomicroscope had found the pigment to be of the congenital bone-spicule type. He had seen golden-brown pigment granules before, in the anterior chamber and they could best be seen by retroillumination.

Iridectomies in bilateral occlusio and seclusio pupillae

Dr. R. W. Danielson presented Robert C., 21 years old, who in June, 1931, had been admitted to the hospital with a history of osteomyelitis of the right hip of five years' duration and of painful and red eyes for a week. He thought he had gotten some acid in his eyes in welding (no electric arc). On examination he was found to have bilateral iritis which resisted all treatment (solid atropin, foreign protein, counter-irritation on temple, levoglaucosan, dionin, and subconjunctival injections of atropin, adrenalin, and cocain). The right pupil did not dilate at all and the left only partially, resulting in occlusio and seclusio pupillae right and seclusio pupillae left. Eserin would then not contract the left pupil in attempting to break the synechiae. The cause was not found. On July 7th, Dr. Melville Black performed an iridectomy with considerable operative difficulty, but with excellent convalescence. On August 13th, Dr. Danielson performed an iridectomy on the left eye with similar results.

The patient left the city soon afterward and was not seen again until the day of presentation when the eyes were quiet and the tension was normal to fingers. The vision with correction was 4/6 in the right eye and 4/4 in the left eye.

Traumatic enophthalmos

Drs. E. B. Swerdfeger and R. W. Danielson presented A. P. S., a 42-year-old man, who on November 11, 1932, had been struck over the left zygomatic region by the crank when starting his truck, producing a typical black eye, except that there was not the usual amount of swelling. The ocular conjunctiva, especially below, had been undermined by a continuous sheet of blood. The movements of the eye were somewhat limited and diplopia could be elicited with a red glass in all fields except down and to the left. The pupils reacted normally, the vision was full, the fundi showed nothing abnormal, and there was no corneal anesthesia. The patient complained of numbness of his left scalp anteriorly and of his upper left teeth. The x-ray report said, "The left inferior margin of the orbit gives the appearance of mild fracture with some overlying edema. This overlying swelling crowds the antrum in its upper portion, but we do not believe there is any blood within the antrum."

It was noticed within a few days that the upper lid did not elevate as well as one would expect. On November 19th, Dr. William H. Crisp suggested that there seemed to be enophthalmos on that side; the measurement with the proptometer on the right was 21 mm.

and on the left was 17 mm. On November 21st, Dr. Swerdfeger found the left maxillary sinus dull and believed it was probably full of blood. He suggested waiting before attempting drainage but on February 17th, reported that the antrum was still somewhat dark.

At the time of presentation there was still 3 mm. of enophthalmos, some tingling of the scalp, and numbness of the teeth, and he said the left lid elevated poorly. The field of vision, visual acuity, and the muscle balance were normal and there was no diplopia. There was still some conjunctival injection. The case was shown to get an explanation of the enophthalmos, and to illustrate a normal eye and muscle balance even though one eye was enophthalmic.

Dr. Danielson discussed the possible etiology for the enophthalmos. Bulging of a wall seemed to be ruled out by the x-ray and lack of interference with any neighboring structure, or with any particular ocular muscle. Herniation of contents through the inferior orbital fissure was possible, but herniation through the superior orbital fissure ought to interfere with all the nerve and blood supply passing through there. Relaxation of the obliques, increased tension of the recti, or rupture of the check ligaments did not seem reasonable. There was not time for fibrous bands to form when the enophthalmos was first noticed. The volume could be lessened by atrophy of the extraocular muscles, by less fluid, by decreased blood supply, or by the absorption of the fat. Muscular atrophy (as against recent theory of muscular enlargement in exophthalmos) seemed unlikely. Any decreased arterial supply did not show in the fundus and there seemed to be no reason why the veins should be carrying away any increased amount of blood or serum. There did not seem to have been time when first noticed for absorption of fat. The picture could fit into a Horner's syndrome except that there was no abnormality of the pupil. There seemed to have been an injury in the posterior part of the orbit, because of the involvement of both branches of the trigeminal nerve.

Discussion. Dr. William H. Crisp said that concussions had been known to cause absorption of tissue elsewhere and did not see why it could not happen in the orbit.

Dr. Maurice Marcove felt that the brief interval, until the enophthalmos was noticed, pointed to a herniation rather than an absorption.

Dr. E. R. Neeper said he doubted whether the eye was actually sunken, for the lateral orbital margin from which measurements were made seemed further out on that side. Dr. Neeper said such measurements were faulty when measured from the orbital margin because of facial asymmetry, and should be made in some manner from the same midpoint, such as the occiput.

Dr. L. L. Davis mentioned that Friedenwald had reported a similar case in which displacement of fat was supposed to be the cause.

Dr. C. E. Walker believed because of the anesthesia that the orbit had been struck above and below.

Dr. Edward Jackson said he was reminded of a case of hyperthyroidism in which exophthalmos suddenly developed within 24 hours. This had been explained by spasm of Mueller's involuntary orbital muscle. Dr. Jackson believed this case was due to paralysis of this muscle and to absorption of fat.

Dr. George Stine believed that paralysis of this involuntary muscle would be due to injury to the muscle itself instead of to the blood supply.

R. W. Danielson,
Secretary.

CHICAGO OPHTHALMOLOGICAL SOCIETY

March 20, 1933

Dr. Wright C. Williams presiding

Disc form degeneration of the macula

Dr. Samuel Wolf presented a man seventy-eight years of age, first seen two weeks before when he came with a complaint of progressive loss of vision for the past six months. There were peripheral riders in both lenses, not sufficient to account for the loss of vision.

The right macula showed several pinhead sized hemorrhages, with a central hemorrhage in the macular area. The left fundus showed a disc-shaped yellowish-gray mass beginning about one-half disc diameter from the temporal side of the disc and extending to the macula, the entire mass being about two disc diameters in size, and raised about two diopters above the retina. There were small pigment areas in the lower part, and one of the arteries was seen to be almost completely empty. The picture was typical of Kuhnt-Junius disc form macular degeneration. The blood pressure was 165/90; heart and lungs were negative. This condition was supposed to be a retinal degeneration based on a vascular degeneration, and the pathology had not been described.

Discussion. Dr. Peter C. Kronfeld said that the pathology of this condition was well known. Frederick Verhoeff presented a case before the meeting of the American Ophthalmological Society in 1928, and reviewed the literature up to date.

Dr. Michael Goldenburg asked Dr. Wolf how long the hemorrhages had been present in the right eye and whether they had changed in appearance and size. They might not be hemorrhages. He had seen fresh or young pigment epithelial cells before they took on the black coloring, which appeared very similar to this. Had the eyes been examined with the red-free light?

Dr. Samuel Wolf replied that the hemorrhages were seen the first day of examination, two weeks ago. They were approximately the same now as when first seen.

Dr. Robert von der Heydt said that there need be no question as to which were young pigment cells and which were recent hemorrhages. Red-free light would show the new pigment cells a canary yellow, and the hemorrhages black. It would be interesting to photograph the right eye periodically presenting the incipience, in order to obtain a series of pictures portraying the sequence of changes.

Dr. Hallard Beard said that the fundus of both eyes had been photographed. They showed very well the changes in the right eye which seemed to be the antecedent of the process, tiny hemorrhages in connection with the retinal vessels, small and very red, and some spots in the same place, evidently older or degenerated, no longer red. The lesion in the left eye was about twice or three times the area of the normal optic nerve. There was one gray streak which might represent the remains of a vessel.

Photographs could be taken from time to time. This case had all the clinical features of a Kuhnt-Junius degeneration. There was a mass of yellow-gray material which lay in front of the pigment layer and behind the nerve fiber layer, which was shown by the fact that the retinal vessels ran over it. Up to two years ago there had been only two cases studied anatomically. One showed a pad of connective tissue which proliferated in concentric layers in some relation to the vessels, but the retinal vessels lay in front of the connective tissues and there was at least some reason for the belief that this was on a hemorrhagic basis; a proliferation following hemorrhage in the macular region.

Dr. M. L. Folk said that Kuhnt's original monograph, published in 1926, gave a number of illustrations of early cases which corresponded to the picture of this right eye. The older cases corresponded to the left eye. There was no doubt about it being a case of Kuhnt-Junius macular degeneration.

Detachment of the retina

Dr. Leo Mayer said that this seventeen-year-old boy came to the Eye and Ear Infirmary on December 27 last, complaining that for three weeks he had noticed a loss of vision in the right eye. He was admitted to the hospital after the diagnosis had been made of complete detachment of the retina. There was light projection and perception; it was not possible to obtain the fields. He was put to bed for one week to see if there would be any improvement, but there was none. On January 8, a Guist operation was done to the

temporal side, about 8 to 10 mm. back, at the highest point of the detachment, which measured about 11 diopters above and temporally. This resulted in a complete reattachment. The condition was so favorable that the boy was kept in bed only one week, but within twenty-four hours after he was up there was a large shelf above, of detached retina. He was put back to bed, but the retina did not reattach, and the temporal side began to detach. Three more trephinings were made in the same region on February 6, one being a little below, because whatever was behind the retina seemed to be causing more detachment below than in any other region. After this, he was kept in bed for one month. The second operation was done six weeks ago and those who had seen him realized that he did not show the picture of a detachment. Visual acuity was 20/100 and there was a fair field. There was no history of injury, but a thorough physical examination revealed several bad teeth. Obviously there was some root infection, but nothing had been done about this, nor would anything be done about it until it was felt safe.

Discussion. Dr. M. L. Folk said that in this case the lesions in the left eye resembled those in the right. It looked like an ordinary atrophic chorioretinitis. There was the question whether the detachment was not caused by the chorioretinitic process.

Dr. Leo Mayer said that chorioretinitis was certainly suggestive as being the cause of the detachment. The marks on the temporal side were due to the trephining, but those on the nasal side and also those in the left eye were due to a chorioretinitis.

Separation of the iris corneal adhesion (seclusio pupillae) for the cure of corneal staphyloma

Dr. Charles G. Darling read a paper on this subject which will be published in this Journal.

Discussion. Dr. Harry Gradle asked whether the separation was accomplished at the expense of Descemet's membrane or at the expense of the iris; also as to the amount of reaction subsequent to operation in children and in adults.

Dr. Charles G. Darling (closing) said the question had been asked as to the technic of operation. It was a cyclodialysis operation up to the point where the spatula was passed far enough forward to separate the iris from the cornea and release the adhesions. In most cases the tension fell to normal, the cornea was flattened, and considerable vision resulted. In older patients, aged fifty to sixty years, with corneal ectasia rather than staphyloma, after the separation the cornea did not flatten out, though the tension was relieved.

A very thin silver spatula was used, made with a dull point and the cutting edge on the side. When it went through the iris and the adhesion, the cutting edge was on the side part of the spatula. There did not seem to be much difficulty in separating the iris which had been on a stretch. What happened to Descemet's membrane he could not say. In some cases when pulling on the iris the staphyloma dimpled in, but it was not difficult to separate the iris, possibly because it was degenerated. There was little reaction, the eye was not reddened or painful. The tension had come down the following day and the patient had no pain. In this case the sclera was so thin that it seemed that the spatula was introduced between the layers of the sclera, as it was only about the thickness of tissue paper.

Complications in cataract extraction: cause, prevention and management

Dr. Oscar B. Nugent read a paper on this subject which will be published in this Journal.

Discussion. Dr. W. A. Fisher referred to a paper he presented before this Society in May, 1932. The technic of his operation contemplated the use of one hand, with traction or suction used for dislocating the lens. He believed that the average surgeon would burst more capsules with forceps than with the suction apparatus, especially if he employed it for dislocating the lens only. Twenty years' experience in operating on all senile cataracts by the capsulotomy method, and a similar time of

operating on the same type of cataract by the intracapsular method, had convinced him that less complications and better vision follow the latter.

Dr. O. B. Nugent (closing) in answer to Dr. Thomas D. Allen said that the great majority of cases of rigid pupil would respond to the ordinary use of euphthalmine and cocaine ointment, five percent of each, two hours before operation.

The first dressing was done twenty-four hours after operation, because the lid stitch should be removed within that time. The eye was not inspected until between the third and fifth days, but since the conjunctival flap was sutured there was so little chance of complication that the eye could be inspected sooner. Atropine was used at the time of first dressing in cases where there was a little unusual discharge from the eye, or if the pupil seemed to be caught in the wound, or if there was any other indication for its use. Detachment of the retina following removal of the capsule had never occurred. Of course one must be extremely careful in removing the capsule. To use force would be hazardous. The cornea must be completely out of the way. The Barraquer capsule forceps with teeth was a good forceps to use, with one blade just skimmed along the surface of the vitreous until the blade reached the opposite side of the pupil, then the forceps was closed, which caused the capsule to be caught in the forceps. It was then gently and slowly moved from one side of the pupil to the other, until the zonule began to tear, when the capsule would usually be removed in toto.

Robert von der Heydt.

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EDITORIAL STAFF

LAWRENCE T. POST, editor
524 Metropolitan building, Saint Louis
WILLIAM H. CRISP, consulting editor
530 Metropolitan building, Denver
EDWARD JACKSON, consulting editor
1120 Republic building, Denver
HANS BARKAN
Stanford University Hospital, San Francisco
HARRY S. GRADLE
58 East Washington street, Chicago
H. ROMMEL HILDRETH
824 Metropolitan building, Saint Louis
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350 West 85th street, New York
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903 Westlake Professional building, Los Angeles
JOHN M. WHEELER
30 West Fifty-ninth street, New York

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DEFECTIVE VISION AND INDUSTRIAL ACCIDENTS

In the course of a half century or so, the attitude of society toward the workman who sustains an injury incidental to his employment has become much more humane than in the earlier decades of modern industrialism. Much of the pioneer legislation in this field is to be credited to Great Britain, where the Employers' Liability Act of 1880 practically ended the doctrine of "common employment" under which a servant or employee could not obtain damages from an employer even though injury had resulted from the negligence of a fellow workman.

The workmen's compensation laws since adopted, especially in England, Germany, and this country, have virtually established the obligation of employers to insure their employees against accident; and few voices can now be heard to complain that there is anything but common justice in this arrangement.

It is true that the amount paid for loss of function of so important an organ as the eye is after all ridiculously inadequate to compensate for the lifelong deprivation sustained. Who among us would feel that a sum of fifteen hundred dollars was anything more than a mere drop in the bucket as payment for total loss of vision of one eye? Yet the injured workman is at least provided with a fund which facilitates adaptation to his modified physical and economic conditions.

The English law goes farther than that of some of our own states, in that the former, since 1906, has conferred the right to compensation on account of a number of occupational diseases, whereas the latter regard such disorders as arising from dangers continuously implied in the nature of the occupation.

It is increasingly recognized that industry should be regulated not only with a view to providing compensation for accidents but also to prevent their occurrence as far as possible. At this year's Greater New York Safety Con-

ference, our collaborator, M. Davidson, ophthalmologist to the New York State Department of Labor, again emphasized the importance of defective vision as a cause of accident. ("Examination of the eyes of industrial employees—why and how?" The Sight-Saving Review, 1933, volume 3, page 38.)

As sources of valuable information on this subject Davidson highly recommends "The functions of an industrial eye clinic," published by the Metropolitan Life Insurance Company, and "Medical supervision and service in industry," published by the National Industrial Conference Board.

Even refractive errors capable of correction with glasses may be regarded as excluding certain individuals from special occupations. It is impracticable for miners to wear correcting lenses in the mine. A young miner with a high hyperopia may go along for years quite safely without correction, but in his later career the uncorrected refractive error not only diminishes efficiency but may be an important source of danger to himself and his workmates.

On the mere score of efficiency, employers in miscellaneous occupations are probably almost as greatly interested in the exclusion of workmen with visual defects as are the Army, the Navy, railway companies, and marine organizations.

It not infrequently happens that an employee who has sustained an injury of apparently minor importance claims compensation on the ground that his vision is much worse than before the accident. The examiner has a strong suspicion that the vision of the eye was always poor and that it has suffered little or no further deterioration on account of injury. But the complete absence of available record as to previous vision makes it impossible to decide what award will be fair to all parties concerned.

It seems reasonable to demand accurate record of visual acuity and ocular condition as a preliminary to employment, and it would surely not be unfair to require that the candidate for employment should present previous records upon demand.

Unfortunately, there is a suggestion that trade unions have set their faces against any such requirement. The unions seem to fear that freedom of employment would be interfered with. If such an attitude is general among the unions, we must feel that they display in this respect an example of short-sighted disregard for the common good.

Davidson suggests that visual standards for industry should vary according to the special requirements of the various occupations, and that all employees should be subjected to annual reexamination. Since optometrists and lay assistants are not qualified to report as to the existence of ocular disease, such industrial eye examinations should be intrusted only to eye physicians, upon either a part-time or a full-time basis. W. H. Crisp.

THE CROSS CYLINDER TEST

The value and method of testing astigmatism with the cross-cylinder will not be learned from written description. But it still seems worth while thus to call attention to it. The only way really to understand it is by using the test; and especially by using it on one's own eyes. For years it has been taught in the Denver Summer Course on Ophthalmology. But each summer some one who had read about it and used it some, and thought he understood it, has been surprised to find that he still had something important to learn about it. This is not peculiar to the cross cylinder. In general we learn by what we attempt to do.

Practice with the cross cylinder does not have to be carried out under the eye of an instructor; but it is most helpful when done on one's own eyes. The instruction for such practice may be obtained from the printed page; but it is not a substitute for actual trials of the test. If your eye has some regular astigmatism, even not more than 0.25 D., repeated testing of it—first as to direction of meridians, then as to amount—will teach more than days of testing of other eyes, either supervised in a clinic, or in private practice.

The cross cylinder carries the testing of ocular refraction over into the realm of scientific accuracy. This it does chiefly by making it practical to repeat the test many times, on each eye tested. The test is repeated by turning the handle of the mounting of the lens. It can be repeated a dozen times in a minute. By this rapid repetition any intelligent patient can choose with certainty which of the two directions is better; and the examiner can be convinced which way the cylinder axis of the lens in the trial frame should be turned, or whether 0.12 D. might be added to, or subtracted from its strength.

It is by repeated observations that we learn a patient's normal pulse, the normal temperature under the tongue, the normal blood count, the normal blood sugar. By repeated observations the astronomer knows the exact position of each star in the sky, or the exact position of the Frauenhofer lines in the solar spectrum. By repetition of tests, engineers determine the exact graduation of scientific instruments, or the length of their base lines, the exact size of the angles in a geodetic survey, to map the position of mountain peaks or the channels for navigation. By repeated observations scientific observers have determined the specific gravity and combining ratio of each element, the chemical composition and molecular weight of each substance used for exact service in the arts.

The cross cylinder test is a recognition of the importance of repeated observations in all scientific studies. It is best used on patients who are accustomed to exact discrimination of form and distinctness in reading. In young children it can be used generally to test the conclusions based on objective testing—especially skiascopy. But children can be quickly taught to look for a change in distinctness of letters. For the illiterate and stupid it can never be the accurate test it is for those accustomed to exact discrimination. It should be used with all the precautions needed for subjective testing with supplementary lenses. Edward Jackson.

ORTHOPTIC EXERCISE

One of the most interesting papers read at the Section meeting at Milwaukee in June was that by Dr. George P. Guibor on the results of careful studies of some fifty cases of amblyopia with associated strabismus, in the ophthalmic clinic at Northwestern University. This was only a preliminary report but represented a painstaking and sincere endeavor to study accurately the problem of the development of amblyopic eyes and record the results without prejudice. The presentation caused an unusual amount of interest and critical comment. The profession has been made keenly aware of the problems of amblyopia and muscle training during the last few years by the persistent efforts of manufacturers of optical instruments to produce and sell satisfactory devices for treatment of these and allied conditions and by the activities of lay refractionists in trying to give the public the idea of ocular muscle difficulties. These latter activities have been called to the attention of ophthalmologists by many patients who have become eye conscious and wish to know whether there is any value in orthoptic exercises.

Most eye physicians are doubtful about this matter. They have learned as students from text-books and lectures that the amblyopic eye can be trained and fusion developed but they can count on their fingers the cases in which they have actually accomplished this. Many of them have started with considerable enthusiasm to train these patients but the enthusiasm has ebbed rapidly away. As Dr. Park Lewis has pointed out (Amer. Jour. Ophth., 1933, v. 16, no. 6, p. 547), few eye physicians have the time to devote to this training nor do many feel that enough is accomplished to justify the hours so spent.

All of the foregoing applies also to the exercising of weak muscles. Most ophthalmologists test the muscle balance for near and far; a smaller number measure the power of the extra and intraocular muscles. If a weakness is found, simple exercises are half-heartedly suggested and are so carried out.

The patient returns in a few months with symptoms perhaps somewhat relieved but with the muscle balance essentially unchanged and the physician is uncertain whether the exercises were in any way responsible for the symptomatic improvement. So the list of doubtful cases is increased.

There are, to be sure, other oculists who take an active interest in muscle difficulties and who have great faith in orthoptic training.

Being much interested in this question the editor has made visits to a number of clinics and private organizations to see what was being done along these lines. In most places there was keen enthusiasm for the straightening of crossed eyes and the virtues of divers methods of accomplishing this were studied and tried assiduously, but very little interest was shown in the follow up of these patients so far as training the fusion sense was concerned. In no clinic visited was orthoptic training being systematically given and in only very few private organizations was this being done.

There is need for many reports of large series of cases impersonally studied. This work should be undertaken in special clinics equipped for the purpose. It should be under the direction of one physician and systematic studies made. In this way it might be determined which of the many instruments on the market were the best; what cases were amenable to treatment and what were the best methods. Dr. Margaret Dobson has described in detail most of the modern instruments in her recent book on orthoptic training (Amer. Jour. Ophth., v. 16, p. 736). Probably training centers for patients as suggested by Dr. Lewis are excellent for treatment of these patients if they happen to live in or near large cities but it is first necessary to answer finally the above questions. Until sure that the right treatment is being prescribed it is hard to work with enthusiasm and conviction, whereas to train one of these individuals requires every possible bit of enthusiasm and conviction, for much time and patience must be consumed.

The results reported from the class conducted by the New York State Commission for the Blind in which of forty-three children with amblyopic eyes only four failed to show improvement in fusion is certainly encouraging.

It is to be hoped that other clinics will follow the lead of Northwestern University and devote a part of their attention to this very important subject. The workers may be sure at least that they will have the attention of the profession as a reward for conscientious efforts because ophthalmologists want to know the truth about orthoptic training, its virtues and its limitations.

Lawrence T. Post.

BOOK NOTICES

Transactions of the Ophthalmological Society of the United Kingdom. 604 pages. Vol. LII, 1932. Published by J. & A. Churchill, London.

The present volume comprises the proceedings of the Ophthalmological Society of the United Kingdom during its fifty-second session, together with the reports of the proceedings of the Affiliated Societies for 1931-1932.

The presidential address is given by Arthur H. H. Sinclair on the development of the intracapsular extraction of cataract. A series of 309 consecutive cases is reported; the final visual acuity, and the complications encountered are tabulated. The Bowman lecture was delivered by J. Van der Hoeve. The ocular movements are discussed in detail and proof presented that a fixed center of rotation does not exist. W. C. Souter presents a case of papillomatosis conjunctivae with spontaneous cure. Two cases of epithelioma of the limbus are shown by Goulden and H. B. Stallard. J. W. Tudor Thomas described the technic of transplanting scleral tissue on to the corneal tissue. Five transplants were made on rabbits. There was a tendency for the scleral tissue to lose its white color and in one case the graft became almost transparent. This work is being continued. A discussion on senile cataract including its preoperative and postoperative management and

complications was opened by A. J. Ballantyne and Sir Arnold Lawson.

The section on diseases of the lids and lacrymal apparatus includes papers on syphilitic tarsitis by Maurice Whiting; external dacryocystorhinostomy by H. M. Torquan and lip-grafting for trichiasis by G. F. Alexander. A statistical survey of 200 cases of retinal detachment is presented by C. D. Shapland, who reports a final cure in 55 cases treated by Gonin's operation. A favorable report is made by David Lees on the use of tryparsamide in syphilitic optic atrophy. Twenty-one cases are reported; in 12 the optic atrophy was arrested and the patient was able to resume work. The theoretical and practical application of tuberculin therapy in ocular tuberculosis is given by Dozent J. Urbanek.

The organization and the administration of school ophthalmic clinics in Scotland is presented by Ernest Thomson. An analysis of 1460 cases of blindness by John Marshall and Charles M. Smith indicated that the cause was myopia in 249, cataract in 223, optic nerve atrophy in 172, iridocyclitis in 150, ulceration of the cornea in 148 and glaucoma in 120. The high incidence of myopia and the absence of trachoma as a cause of blindness are noteworthy.

The report of the Oxford Ophthalmological Congress for 1932 and other local societies follows.

A symposium on the treatment of non-paralytic squint is given by Luther C. Peter, Bernard Chavosse, Maddox and Van der Hoeve. The Doyne Memorial Lecture is given by J. Van der Hoeve on the eye symptoms in phakomatosis. The diseases of Recklinghausen, von Hippel-Lindau, and of Bourneville are considered and the term "phakomatosis" coined as a group classification. Dr. C. Pascheff presented a paper on the laws of true trachoma. Very good photographs of the different forms of trachoma are shown. Mr. George W. Black analyzes 37 cases of retinal detachments treated at Moorfield's by the application of caustic potash to the exposed choroid. Cures are reported in 40 percent of the cases so treated. The technic of the Guist-Linder method of treatment of retinal detachments is shown by Mr. H. A. Dastoon. Dr. Luther C. Peter presents short descriptions of the recession operation and of the O'Connor cinch shortening operation. Mr. Norman Burgess gives a paper of general interest on the relationship of ophthalmology and dermatology.

The wide range of subjects presented and the general excellent quality of material included in this volume is in keeping with the standards of the societies represented. William M. James.

Science and Pseudo-science. By F. W. Eldridge-Green, M.D. 104 pages. John Bale, Sons and Danielsson, Ltd., London. 1933. Price 2/6.

This book is devoted largely to criticism of the misuse of power of certain scientific bodies over scientific workers and their literary products. The author feels that in many cases injustice is done because of personal considerations. Much of the book is devoted to the author's own case. He believes that the situation might be remedied by the existence of an "Appeal Board for Science" which would act as a referee in cases in which scientists thought that they had not received a fair hearing by local and national societies. One short chapter is occupied by some discussion of the author's theory of vision.

Though there is much truth in the contention regarding unfairness in some cases, the editor does not feel sure that members of the appeal board would not be governed by much the same prejudices as the existing organizations. There is small consolation to the worker in the realization that in the long run truth will prevail.

Lawrence T. Post.

CORRESPONDENCE

Translations of Fuchs's Textbook

Anent the translation of the fifteenth German edition of Fuchs's textbook, a copy of the following letter from the late Alexander Duane was received from Dr. George W. Jean. It illustrates the difficulties of the translator and the meticulous care required to avoid errors.

139 East 37th Street
New York
Aug. 12, 1911

Dear Doctor Jean:

I am extremely indebted to you for your list of errata and wish to thank you for taking so much trouble. A few of the errors had been already detected and the corrections have been made. But the others had escaped me, in spite of what I thought was a careful re-reading of the text. It only shows how the most obvious errors will escape one. Prof. Fuchs himself tells me of one that passed through the German editions up to the last one; the sense being completely reversed by the error. I myself have written unconsciously "myopic" when I meant "hypermetropic" and committed similar blunders. The blunder you note on p. 28 seems particularly stupid for, of course, I should never have thought of locating the far point between the *mirror* and the observer's eye. What I doubtless had in mind was "between mirror and patient," although that is not just what Dr. Fuchs said.

Some of the other errors I do not feel so badly about, because they represent simply the omissions of German words which had been inserted in the newer editions but which in comparing the books I had overlooked. Such errors are almost unavoidable, for strive as we will to compare line by line, the deadly monotony of the task seems to put us (at least me) into a state of *mental obfuscation,* so that almost any slip may pass unnoticed.

The error on p. 449 is really, I am sure, a misprint. "Of a normal depth" should have been "of abnormal depth."

I trust that if you note any other errors you will not hesitate to let me know. With many thanks for your kindness and care, I remain,

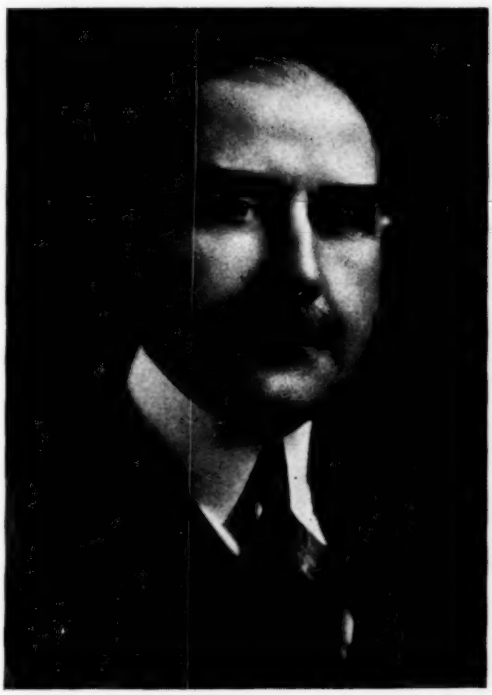
Very sincerely yours,
Alexander Duane.

OBITUARIES

George Francis Suker

George Francis Suker was born October 12, 1869. After his preliminary school education he attended the University of Michigan from which he was graduated in 1892. Subsequent to graduation, he was an assistant in the Eye, Ear and Nose Department to Dr. Carrow for several years. He came to Chicago in 1902 and early established himself as a scientific clinician.

In 1905 he was elected secretary of the American Academy of Ophthalmology and Oto-Laryngology, which



GEORGE FRANCIS SUKER

office he held for a period of seven years. The next year, when only 43 years of age, he was elected president of the Academy. The meeting at which he presided was held in Niagara Falls, Ontario. Shortly after the outbreak of the war he was commissioned in the Medical Corps and sent to Camp Custer, Michigan, where he served as Chief of the Eye, Ear, Nose and Throat Department until his discharge in the summer of 1919.

As president of the Chicago Ophthalmology Society in 1928 he did much to build the clinical activities of that society, and general recognition of his executive ability was shown in his selection as Chairman in the Section of Ophthalmology of the American Medi-

cal Association in 1931. His sudden death on July 2, 1933 was a severe loss to ophthalmology.

George Suker was one of the foremost clinical teachers of the Midwest and in his position as Chief of Staff of the Eye Department of Cook County Hospital and as Ophthalmologist to the Chicago Post Graduate Hospital, his opportunities for clinical didactic work were almost unlimited. His special interest lay in ophthalmic surgery and ophthalmic neurology, and it was one of his greatest pleasures to lead his young assistants along these paths. His frequent demonstrations of interesting and rare fundus pathology in patients at the Cook County Hospital will long be remembered by the ophthalmologists of the Midwest. A rather prolific writer by nature, George Suker contributed much to ophthalmic literature.

His wife, Lillian, accompanied him to the majority of National Medical meetings and the news of her sad death, preceding his by but a few months, came as a shock to all who had known her. They had no children, but numerable younger colleagues look upon George Suker in gratitude as having been their guiding father in their early days as ophthalmologists. His life work has set an example of great enthusiasm and devotion for a beloved specialty. This achievement of an ideal, as well as his kind personality, has indelibly placed his memory among the treasures of his colleagues.

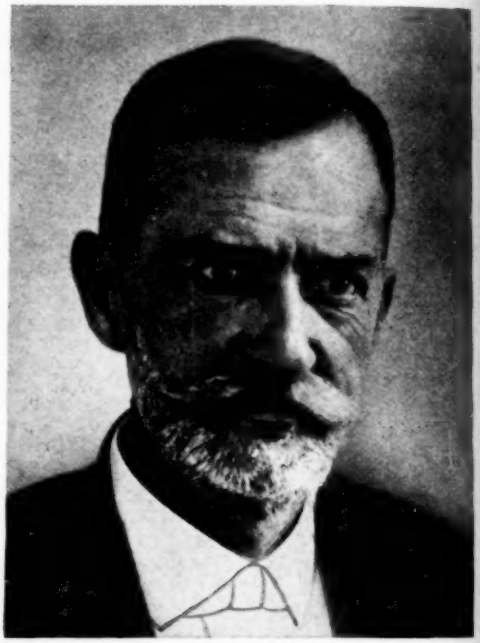
Harry S. Gradle.

Henry Dickson Bruns, M.D.

Henry Dickson Bruns, M.D., of New Orleans, one of the ablest and most accomplished of American ophthalmologists, knew for several years before his death that his days were numbered. But he fought a good fight, he finished his course, he kept the faith. Born a patrician socially and professionally, his standard was never lowered either to insinuation or outright attack. A gentleman, heart and soul. God knows there are few of them left, and he was one of them. The heart of a lion, the soul of a Chevalier Bayard—*sans peur et sans reproche.*

Small of stature, a giant mentally and morally, he never quailed before any of the problems which he faced. Broad and generous of mind and spirit, he never failed to praise, aid and encourage the efforts of his colleagues, young and old. Faith, courage, philosophy were his watchwords; and hope and charity were not laggards in his active life.

He was the grandson of Henry L. Bruns, L.L.D. professor of Greek and Latin in the College of Charleston, and of Samuel Henry Dickson, L.L.D., M.D., professor of the Practice of Medicine in the Medical College of Charleston, S.C., in the College of Physicians and Surgeons, New York, and in Jefferson Medical College, Philadelphia; author of "Dickson's Practice of Medicine."



Henry Dickson Bruns

Dr. Bruns's father, John Dickson Bruns, M.D., was a surgeon in the army of the Confederate States of America, throughout the War Between the States. He was professor of physiology in the Charity Hospital School of Medicine, New Orleans, and was one of the organizers of the White League of Louisiana, which, in a pitched battle in the streets of New Orleans, drove out

the Reconstruction Government, in 1874; he was a youthful friend of Wm. Gilmore Sims, Paul Hayne and Henry Timrod—a scholar and a public speaker.

So Henry Dickson Bruns came naturally by the talent which made him, not only a Southern but a national figure in ophthalmology, and a defender of his racial and political faith among his own people. He died in the seventy-fourth year of his age, at his home in New Orleans, May 19, 1933.

Born in Charleston, S.C., the family moved to New Orleans, and in the latter city Dr. Bruns got his primary schooling. Then to the University of Virginia, where he was a member of Pi Kappa Alpha fraternity, and on returning from there to New Orleans in 1878 he was stricken with yellow fever in the last great epidemic of the scourge in that city. He got his degree in medicine at Jefferson, Philadelphia, where he graduated in 1881, receiving the Henry C. Lea prize of $100.00 for the best graduation thesis, his subject being Leprosy. Post-graduate work was done in Philadelphia and New York.

Returning to New Orleans in 1883 he began practice in diseases of the eye and ear (calling himself an oculist—he always thought the term "ophthalmologist" pedantic) and established the first out-patient clinic in the South in Charity Hospital. In 1889 he was appointed pathologist to this institution and continued as such for several years.

About this time he became one of the editors of the New Orleans Medical and Surgical Journal, and was one of the founders of the New Orleans Polyclinic, later the Graduate Medical Department of Tulane University, where he was professor of Diseases of the Eye until his resignation in 1893, to take charge as Surgeon of the Eye Department in the New Orleans Eye, Ear, Nose and Throat Hospital. While associated with Tulane, with the co-operation of a few public-spirited women he established the first training school for professional nurses in the South. In this school Dr. Bruns taught physiology.

During these years social and political affairs occupied his attention. He married; he fought political fights for his kind and his country—he was ever a champion of the right, and, in spite of his wish that it might better not be mentioned now, it must be recorded for history's sake that Dr. Bruns chose to throw his influence into the full force of the famous anti-lottery campaign. He took the stump, as he had done before in civic campaigns, and as he did afterward, in other evidences of the great courage of his convictions. So, one night, in troublous times, but true to his faith, he took a leading part in the great Mass Meeting at Canal and St. Charles Streets which resolved upon and carried out the public execution of the "dagoes" charged with the murder of Chief of Police Hennessey. Then he served for weeks on the Committee of Public Safety following this event and ever and always assumed and acknowledged his full share of the responsibility. Those were the days of men! And Bruns was one of them!

In 1893 he was made surgeon in charge of the Eye Department in the New Orleans Eye, Ear, Nose and Throat Hospital, and until his death rendered outstanding service there.

During these years his civic duties ever appealed to him, and time after time we find him on the stump pleading for clean and honest government and constructive reforms. He held many political appointments and as far back as 1898 strove for the recognition of woman's suffrage. One of his cherished memories was that as a member of the Louisiana Constitutional Convention of 1898, he refused to sign the new constitution because convinced that the "grandfather clause," de-franchising negroes, was unconstitutional and fraudulent; and was one of two who refused to accept extra pay when the session was extended, because, as he said: "members had sworn not to increase their emoluments." Thus spoke the man, characteristically.

In 1901 he was elected to membership in the American Ophthalmological Society which he always held in the highest regard, and in 1907 he was elected president of the Louisiana State Medical Society. During all these years Dr. Bruns was a frequent contributor

to medical literature in the field of ophthalmology. His was indeed a busy and exciting life. In 1924 the University of Virginia awarded him the Phi Beta Kappa key.

Showing his wide variety of interests it may be mentioned that Dr. Bruns was at the time of his death, or had been, a member of: The Orleans Parish Medical Society, Louisiana State Medical Society, American Medical Association, National Municipal League, American Free Trade League, National Economic League, Sentinels of the Republic, Alumni Association of University of Virginia, Colonade Club of University of Virginia, Rigolets Hunting and Fishing Club of New Orleans, and The Isaak Walton League of America.

His easy familiarity with modern languages as well as the classics, his wide reading and retentive mind, a rare sense of humor never tolerating the crass or gross, clothed him as with a mantle of the finest culture and richest cultivation. His spoken and written words a joy to the purist, he was one of the most charming and interesting of conversationalists.

This is a human interest story, from here on: One who has been associated with Dr. Bruns for years writes, in effect: "I can attest that he had a most forceful and profound influence upon his patients—never familiar, but always gentle and kind. At once he gained their confidence as strangers, and when they became his patients they were exceedingly loyal and this loyalty was never lost. Dr. Bruns was plain-spoken, yet always the soul of kindness, and really a master, when the necessity arose, of breaking unhappy news to his patients. With an analytical mind, he kept most clear-cut and concise records. No rule of thumb was his, but day after day he recorded the outlines of his cases and, true to his training, this was often done in forceful and even beautiful literary style."

And from one of his few intimates, now living in New Orleans, a distinguished member of the medical profession: "Dr. Bruns's social position was of the highest and his circle of acquaintance was large, but he did not cultivate nor permit the intimacy of many, either in or out of the profession. He bestowed the term 'friend' on few, but those select ones could depend on his interest and loyalty to the utmost.

"He was not a member of any church; his religious views were philosophic; never dogmatic, and he avoided discussion on the subject.

"He was fond of his beagle and hunting and fishing sports, but held no membership in any social club. His work done, his home and his books took up his time. He appreciated good music and enjoyed the seasons of the French Opera for which New Orleans was formerly noted."

In latter years, the stout Bruns heart, overloaded by an old pulmonary fibrosis, showed signs of inevitable stress, and though not one to complain those near to him knew it was a sore distress to have to foreswear the beagle pack in the sunny flowered fields and hedgerows of old Virginia, where, near Howardsville, was his beloved summer home.

Hundreds of his students live after him and love him, and revere his memory. His widow, who was Kate Logan, daughter of General T. M. Logan, Confederate States of America, of Virginia, and four grown sons survive.

A bibliography (partial) of his contributions to medical literature is appended. The writer loved him. *Requiescat in pace.*

J. W. Jervey.

Bibliography

Acute plastic iritis. Trans. Louisiana State Med. Soc., 1883.

The pathological aspect of cancer. New Orleans Med. and Surg. Jour., 1889.

Biographical sketch of Dr. Samuel M. Bemiss. New Orleans Med. and Surg. Jour. Jan., 1885.

On the relation between the diseases of the teeth and the ears. Archives of Otology, v. 14, no. 1, 1885.

On the use of mydriatics in determining errors of refraction and the correction of the whole error so determined. Amer. Jour. Ophth., June, 1888.

Some of our forgotten worthies. Oration before the Louisiana state medical association. Trans. of the Assoc., 1883.

Notes on the examination of the urine, of sputum and of tumours, from the Pathological Laboratory of the Charity Hospital, New Orleans. New York Med. News, Sept. 7, 1895.

Descemetitis a symptom of inflammation in any portion of the uvea: Serous iritis not a disease per se. Arch. of Ophth., v. 30, 1901.

Diseases of the eye in the White and in the Negro Races. Trans. Amer. Ophth. Soc., 1893.

Gonorrhoeal ophthalmia in the adult and the infant. New Orleans Med. and Surg. Jour., Nov., 1905.

Phlyctenular ophthalmia in the White and in the Black Races, with notes on its treatment. New Orleans Med. and Surg. Jour., August, 1903.

Three unusual clinical observations. Change in astigmatism produced by chalazion, etc. Ophth. Rec., Sept., 1905.

Ptosis and the operation of motais. New Orleans Med. and Surg. Jour., June, 1905.

Experiences during the yellow fever epidemic of 1905. New Orleans Med. and Surg. Jour., Sept., 1905.

Iritis a self-limited disease. Preliminary note on sixty-nine cases. Trans. Louisiana State Med. Soc., 1893.

Diphtheria of the conjunctiva in the far south. New Orleans Med. and Surg. Jour., v. 59, 1906.

Removal of the lens in high myopia. Trans. Tenth International Congress of Ophth., Lucerne, 1904. New Orleans Med. and Surg. Jour., v. 57.

Ocular therapeutics, Review of Oliver's Translation of Chlemann's Ocular therapeutics. New Orleans Med. and Surg. Jour., July, 1899.

Ophthalmic surgery. Review of J. Meller's Hand book of ophthalmic surgery. New Orleans Med. and Surg. Jour., Nov., 1909.

A case of spasm of the retinal arteries. Trans. Amer. Ophth. Soc., 1910. New Orleans Med. and Surg. Jour., 1911.

Phlyctenular ophthalmia and its etiology. Jour. A.M.A., Sept., 21, 1912.

Auto-intoxication and the eye. Conservation of vision series. Pamphlet VI, 1914.

Anomalies of the extrinsic muscles of the eye, Hansell and Reber Review. New Orleans Med. and Surg. Jour., 1912.

On the ambulant after-treatment of cataract extraction, with a note on post-operative delirium and on striped keratitis. Trans. of Amer. Ophth. Soc., 1916. Annals of Ophth., Oct., 1916.

On some minor matters. New Orleans Med. and Surg. Jour., Sept., 1918.

Is argyrol useless? New Orleans Med. and Surg. Jour., April, 1919.

Is trachoma prevalent in New Orleans? New Orleans Med. and Surg. Jour., Sept., 1920.

Syphilis and iritis. Arch. of Ophth., 1925, v. 54.

Etiology of glaucoma. Amer. Jour. Ophth., 1925, v. 8.

Mind your eyes. Gare a vos Yeux. Translated, by permission, from The French of Francisque Sarcey. New Orleans, 1886.

Injuries of the eye. Reference hand book of the medical sciences.

A note on glaucoma. New Orleans Med. and Surg. Jour., March, 1932.

Address Before State Medical Society of Mississippi.

Address Before State Medical Society of Alabama.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is only mentioned in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic disease and parasites
18. Hygiene, sociology, education, and history
19. Anatomy and embryology

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1. GENERAL METHODS OF DIAGNOSIS

Bailliart, P. **Moving pictures of the fundus.** Arch. de Oft. Hisp.-Amer., 1933, v. 33, April, p. 233.

The Argentine ophthalmologist Lijo Pavia first successfully demonstrated the possibility of moving pictures of the fundus, and together with the writer was to demonstrate at the Madrid Congress a case of spontaneous pulsation of submacular choroidal arterioles in a senile lesion and a case of induced arterial pulsation, whose proper technique is shown by slow motion to be productive of sudden violent arterial contraction. M. Davidson.

Ferree, C. E., Rand, G., and Monroe, M. M. **Critical values for the limits of the color fields in the eight principal meridional quadrants taken separately.** Amer. Jour. Ophth., 1933, v. 16, July, pp. 577-589.

Harman, N. B. **A hand slitlamp.** The Lancet, 1933, v. 224, March 25, p. 642.

The author gives a description and a diagram of the slitlamp that he has invented. Ralph W. Danielson.

Müller, H. K., and Franceschetti, A. **The influence of intensity of illumination of the ocular fundus through various redfree filters and its importance for ophthalmoscopy in redfree light.** Klin. M. f. Augenh., 1933, v. 90, May, p. 633.

The authors therefore tried to increase the intensity of illumination by changing the redfree filter after careful analysis of the ordinary filters (using the one devised by Vogt as standard). With the new filter pathological changes in the fundus could be diagnosed with the same accuracy as by Vogt's method. The advantages of the apparatus over Vogt's method are simplicity of technique, large illuminated retinal area, stereoscopic observation, and rapid modification of intensity of illumination. C. Zimmermann.

Rosebrough, F. H. **Pathology of the eye: preparing an eye for microscopical examination.** Southern Med. Jour., 1933, v. 26, March, p. 282.

This paper consists of well-arranged textbook material and the author's modifications. He uses the dry celloidin method. (Twelve references.)

Ralph W. Danielson.

Thies, O. **Ophthalmological interpretation of rare roentgen findings on the skull.** Klin. M. f. Augenh., 1933, 91, July, p. 38. (Ill.)

Nine cases of ocular affections are reported in which roentgenography of the skull permitted exact diagnosis, prognosis, and therapy for which the ophthalmic surgeon in consultation had to give final judgment. It is urged that ophthalmologists become familiar with roentgen diagnosis of the skull.

C. Zimmermann.

2. THERAPEUTICS AND OPERATIONS

Evans, J. N. **Eye pad for the administration of heat treatments.** Trans. Amer. Ophth., Soc., 1932, v. 30, p. 390.

A triangular rubber pad with a convex metal back and containing a combination of acetates, sodium sulphate, and glycerin is boiled for fifteen minutes. This converts the chemicals from solid to liquid. With the reformation of crystals a temperature of 120° F. is maintained for three quarters of an hour. C. Allen Dickey.

Holth, S. **Automatic regulation of heating in electrical hot air sterilization of surgical eye instruments and silk for sutures.** Brit. Jour. Ophth., 1933, v. 17, July, p. 402.

This is a description of a small cabinet so constructed, heated, and automatically controlled that constant temperature may be maintained or interrupted as desired by the use of the thermoregulator. By experiment as to the effect of heat on silk sutures and fine-edged knives, and also from the results of bacterial investigations, the author believes that temperature maintained between 160° to 165° in this cabinet meets every need. D. F. Harbridge.

Krishnaswami, C. V. **A new anterior synechia knife.** Brit. Jour. Ophth., 1933, v. 17, July, p. 419.

In releasing the attachment of the iris the difficulty encountered when a Graefe or Ziegler knife becomes entangled is avoided by using the author's instrument. This is a narrow blade with a doubly cutting edge, the point rounded and noncutting. After a narrow keratome incision where the anterior chamber is deepest, the instrument is introduced, and first one side of the adhesion is cut and then the other. D. F. Harbridge.

Kubik, J. **The action of diocaine.** Klin. M. f. Augenh., 1933, v. 90, May, p. 661.

At Elschnig's clinic diocaine has during the last three years been exclusively used as an anesthetic for tonometry without eliciting one attack of glaucoma. Diocaine does not produce change in size of pupil or vessels

C. Zimmermann.

Shimkin, N. **Pantocaine, a new anesthetic in ophthalmic practice.** Folia Ophth. Orientalia, 1933, v. 1, Feb., pp. 192-205.

Shimkin reaches the conclusion that this anesthetic should replace cocaine in ophthalmic practice. For operations in which the anterior chamber is to be opened he uses 1 percent pantocaine solution plus adrenalin (1 to 1000). In operations on the eyelids he injects 1 c.c. of 0.5 percent pantocaine plus adrenalin, which gives a quick, strong, and lasting anesthesia in which not only the sense of pain but that of pressure is paralyzed. Owing to slight dilatation of the vessels which the anesthetic induces there is slightly more bleeding than with cocaine or novocaine. The author finds 1 percent pantocaine the best anesthetic for use in the following conditions: (1) In the treatment of all corneal affections of traumatic or infectious origin. The anesthetic is not toxic for epithelium and has the advantage over cocaine that it induces slight vasodilatation, thus promoting a quicker vascularization of corneal ulcers and regeneration of the injured epithelium. (2) In all superficial operations on the cornea such as cauterization, curetting, paracentesis, Saemisch section, application of caustics to corneal ulcers, and tattooing. (3) For painless application of various caustics in all diseases of the conjunctiva. (4) In operations on the conjunctiva such as scarification and expression of trachoma granules. Shimkin mentions also that pantocaine is very soluble, that it remains unchanged by frequent boiling, that it does not re-

quire a narcotic license for its purchase, and that it is cheaper than cocaine.

Phillips Thygeson.

Strebel, J. **Electrophthalmosurgery. Cure of epiphora by thermocoagulation of the lacrimal gland and its ducts with diathermy.** Klin. M. f. Augenh., 1933, v. 663, May, p. 663.

Strebel reports his excellent results with electrocoagulation in various ocular affections A third degree burn is produced by means of a small electrode. It is indicated in benign and malign tumors of lids and orbit, retinal detachment, serpent ulcer, tumors of the eyeball, and posterior sclerotomy for glaucoma. The method is described in detail. C. Zimmermann.

Von Grolman, G. **Medical and surgical diathermy in ophthalmology.** Arch. de Oft. de Buenos Aires, 1932, v. 7, pp. 43, 94, 168, 228, 343, 475, 551, 666, 747.

This is a very lengthy article covering history, nature, instruments, action, and technique of application of high frequency currents for both medical and surgical purposes. The author claims to have treated with success blepharitis, eczema, herpes zoster, spring catarrh, atonic ulcers, leucomas, different types of keratitis, episcleritis, iritis, iridocyclitis, hemorrhages into the anterior chamber, vitreous opacities, glaucoma, cataract, retinal embolism, recent paralysis of eye muscles, orbital neuralgia, benign and malignant tumors, chalazion, trachoma, trichiasis, pterygium, pannus, corneal ulcer, and orbital tumor. Eighty-nine clinical histories are reported. (Drawings, photographs, and bibliography.)

R. Castroviejo.

3. PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Arjona, J. **False depth perception from marked color contrasts.** Arch. de Oft. Hisp.-Amer., 1933, v. 33, June, p. 369.

The illusion, observed under certain circumstances, of colored lights being at different planes when really in the same plane has been studied by the writer at from three to ninety meters. With a red glass on one eye and a blue glass on the other the phenomenon disappears. The illusion also disappears with increase of brightness of surrounding field and with decrease of distance. Neither the theory of chromatic aberration (since the variation is binocular) nor the theory of decentration of circles of diffusion (since the phenomenon increases with distance and therefore while this factor is becoming more and more negligible) is satisfactory to the writer, who suggests a psychic factor. M. Davidson.

Crisp, W. H. **The cross cylinder test with special relation to the determination of the axis of astigmatism.** Arch. de Oft. de Buenos Aires, 1932, v. 7, July, pp. 387-403.

A Spanish translation of the paper published in the American Journal of Ophthalmology, 1932, volume 15, page 729.

Dupuy-Dutemps, L. **Adaptation of the aphakic eye to near vision by adjusting the position of the distance lens.** Ann. d'Ocul., 1933, v. 170, June, pp. 509-512.

The author develops a mathematical formula for determining at what position in front of an aphakic eye the distance lens must be placed to focus a near object on the retina.

H. Rommel Hildreth.

Font, M. McK. **"Dorothy"—A case of reading disability.** Delaware State Med. Jour., 1933, v. 5, April, p. 95.

A case of this type is reported in detail psychologically. Inasmuch as no mention is made of vision or of refraction, the reviewer cannot but wonder whether Dorothy may not need correction of a high astigmatism.

Ralph W. Danielson.

Fry, G. A., and Bartley, S. H. **The brilliance of an object seen binocularly.** Amer. Jour. Ophth., 1933, v. 16, Aug., p. 687.

Granstrom, K. O. **Changes in refraction in diabetes mellitus.** Acta Ophth., 1933, v. 11, nos. 1-2, p. 1.

From review of the literature and study of over one hundred cases the author concludes that transitory refractive changes in diabetes occur at all ages, and are more pronounced in the young. Hyperopia is more frequent than myopia, usually occurs at institution of diabetic therapy and is associated with diminishing glycosuria: in patients under thirty years of age it is associated with diminished accommodation. Myopia is found in untreated cases and is associated with a high glycosuria and blood sugar. Studies with the stigmatoscope indicate that these refractive changes are due to intracapsular changes in the lenticular index of refraction. The author believes that the demonstrated retention of salt in the body tissues in cases of diabetes probably also occurs in the lens nucleus, raising the index of refraction and causing a myopia. With the passing of glycosuria the retained salt leads to edema in the tissues, and edema in the lens nucleus lowers the index of refraction and leads to hyperopia.

Ray K. Daily.

Heinonen, O. **Astigmatism in deaf mutes, and the constitutional diathesis of persons with astigmatism.** Acta Ophth., 1933, v. 11, nos. 1-2, p. 176.

A review of the literature and study of the available material show greater frequency of retinitis pigmentosa, strabismus, and astigmatism in congenital than in acquired deaf-mutism. Constitutional differences between emmetropes and persons with astigmatism could not be demonstrated.

Ray K. Daily.

Jackson, Edward. **The cross cylinder.** Amer. Jour. Ophth., 1933, v. 16, July, pp. 600-602.

Lopez Abadia, J. **Should the Fukala-Vacher operation be restored?** Arch. de Oft. Hisp.-Amer., 1933, v. 33, May, p. 329.

On the basis of forty-five cases which the author has operated on in the past six years, of which three are reported in detail, the following conclusions are arrived at: The operation should be resorted to in adults with fifteen or more diopters of myopia, mild fundus lesions, and a visual acuity of at least one-third, and in children and adolescents whose myopia in diopters equals or exceeds their age in years. The progress of myopia is not arrested nor detachment prevented by the operation, but neither are these desiderata achieved by full correction. Visual acuity is the same or better after the operation in about seventy percent of the cases.

M. Davidson.

MacDonald, A. E. **Condensed vision chart.** Trans. Amer. Ophth. Soc., 1932, v. 30, pp. 389-390.

A chart, two by five inches, containing one or more of all the standard characters except 6/60 is presented.

C. Allen Dickey.

Osterberg, G. **Some researches on the peripheral limits of the field of vision of the dark-adapted eye.** Acta Ophth., 1933, v. 11, nos. 1-2, p. 204.

With an improvised apparatus having luminous fixation and test objects the fields of eight young and five old individuals were taken in a dark room under different degrees of illumination. They showed progressive concentric contraction with decreasing illumination, the form of the field remaining unchanged. The intensity of illumination below which the visual field fell to zero was ten times greater for old people than for the young.

Ray K. Daily.

Polack, A. **A note on the method of Holmgren.** Ann. d'Ocul., 1933, v. 170, June, pp. 513-515.

The author prefers the Seebeck's method, which classifies a number of colored objects according to their reciprocal resemblance or lack of resemblance. Since Seebeck the studies of congenital alterations of chromatic sense are in the nature of theories.

H. Rommel Hildreth.

Satanowsky, P. **What is the cause of torticollis of ocular origin.?** Arch. de Oft. de Buenos Aires, 1932, v. 7, Sept., pp. 547-550.

The author reports a case with paralysis of the superior oblique in one eye and very poor vision in the other. Though there was no diplopia, the patient showed the characteristics of torticollis present in patients with paralysis of eye muscles. The author believes that the torticollis is established to compensate the functional deficiency of the muscles, but has nothing to do with the diplopia. R. Castroviejo.

Smukler, M. E. **An improved Holzer Priestley-Smith tape for rapid and accurate measurements of strabismus.** Amer. Jour. Ophth., 1933, v. 16, July, pp. 621-622.

Terson, A. **Lenses with opaque segments employed palliatively and diagnostically.** Ann. d'Ocul., 1933, v. 170, June, pp. 503-509.

Several types of partially frosted segments are illustrated. They are best used in cases of paralytic strabismus to obscure one image in the field of diplopia. A colored lens may be used with a frosted segment.

H. Rommel Hildreth.

Vazquez Barrière, A. **Myopia in relation to the general biologic laws.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Sept., pp. 515-546.

This reviews in detail the old and modern theories of etiology. The author arrives at the conclusion that the greater proportion of myopia in advancing school years has no relation to the amount of eye work, depending exclusively on inheritance and natural body growth. (Bibliography.)

R. Castroviejo.

Velez, D. M. **Chromoptometry and measurement of defects of refraction of the eye.** Anal. Soc. Mexicana de Oft. y Oto-Rino-Laring., 1932, v. 9, July-Dec., p. 175.

The author describes in Spanish, with a number of illustrations, the principles and technique of utilizing red and blue images for measurement of refraction. His conclusions as to the value of the test are stated in language similar to that of the manufacturers of apparatus recently sold for this purpose in the United States. W. H. Crisp.

Verhoeff, F. H. **An improved and a new test for stereoscopic vision.** Amer. Jour. Ophth., 1933, v. 16, July, pp. 589-591.

4. OCULAR MOVEMENTS

Caussé, Raoul. **Demonstration of contradeviation of the eyes by means of Struycken's apparatus.** Arch. d'Opht., 1933, v. 50, May, p. 353.

After a review of the literature the writer mentions the difficulties of clinically obtaining measurements in man. The Struycken apparatus consists of a tube so arranged with prisms and lenses that an image of the vessels on both sides of the cornea is seen simultaneously in contact with a scale. By noting the position of certain vessels in relation to the scale before the head is tilted, and then again after tilting has taken place, while the patient fixes a certain line of test letters, the contradeviation of the eye is measured by the displacement of the vessels in relation to the scale. (Diagrams.)

M. F. Weymann.

Herzau, W. **Squint amblyopia and its treatment.** Klin. M. f. Augenh., 1933, v. 90, May, p. 612

Herzau reports on thirty-seven children, in all of whom permanent closure of the good eye achieved improvement of vision in the other eye. An unfavorable influence of the very slight anisometropia was not observed. The youngest children are most rapidly improved by permanent bandage. After correction binocular fusion in the stereoscope and only rarely binocular depth perception were observed. C. Zimmermann.

Jameson, P. C. **Some essentials and securities which stabilize muscle operations.** Trans. Amer. Ophth. Soc., 1932, v. 30, p. 38. (See Amer. Jour. Ophth., 1933, v. 16, Feb., p. 169.)

Rosengren, B. **Diplopia following radical frontal sinus operations.** Acta Ophth., 1933, v. 11, nos. 1-2, p. 161.

To explain vertical diplopia in the upper field after radical frontal sinus op-

erations, the author injected the two eyes of a cadaver with paraffin, put sutures on the inferior recti, stretched these sutures over pulleys, and attached weights to them. Then he loosened one trochlea from its attachment and compared the upward excursions of the two eyes. The conclusions are that the vertical diplopia in the lower field is due to insufficiency of the superior oblique and the diplopia in the upper field to weakening of the fascial envelope around the trochlea. Most cases present a combination of these factors, and are caused by a misplacement of the trochlea resulting from retraction of the periosteum, especially after excessive removal of the orbital roof. At the operation the trochlea should be fixed in its correct position by suturing the periosteum. If the diplopia persists this may be done at a secondary operation.

Ray K. Daily.

Seale, E. A. **Paralytic alternating strabismus ? of congenital origin.** Brit. Jour. Ophth., 1933, v. 17, July, p. 415.

In a child of five years, each eye could fix equally well. When the right fixed, the left looked in and the left lid drooped. On fixing with the left eye the right turned up and in, the eye being wide open. There was a left facial paralysis extending to the tongue and lips. Hearing was poor on the left side. Careful study and consultation of Paton, Holmes, and Duke-Elder's contributions placed the chief seat of the defect in the sixth nerve nucleus on the right side. D. F. Harbridge.

Stutterheim, N. A. **The primary position of the eyes.** Brit. Jour. Ophth., 1933, v. 17, July, p. 394.

The real primary position is regarded as one of divergence of the visual axes. According to the author's conception of ocular motility, the extrinsic muscles act as tensors between the primary position and the edge of the fixation field, and the place of the muscular antagonism which dominates movements of arms and legs is taken by reciprocal action between extrinsic muscular power and the elasticity of the primary position. D. F. Harbridge.

Vestergaard, J. **Bielschowsky's strabismus.** Acta Ophth., 1933, v. 11, nos. 1-2, p. 218.

The symptom complex includes vertical strabismus with symptoms pointing to paresis of the superior oblique but with identical primary and secondary angles of deviation, no limitation of motion, and spasm of an upward rotator. The author takes issue with Bielschowsky on the etiology. Bielschowsky ascribes the divergence to anatomical anomalies in the fascial ligament of the superior oblique, but the author argues that it is due to a supranuclear weakness of coordination.

Ray K. Daily.

5. CONJUNCTIVA

Bartolotta, E. **Prophylaxis of trachoma.** Folia Ophth. Orientalia, 1933, v. 1, Feb., pp. 206-208.

The author is of the opinion that trachoma can no longer be considered a specific disease of the conjunctiva. He believes that certain cases are constitutional and require one type of treatment while others are infectious and need to be treated in a different manner. He classifies all diseases of the conjunctiva, no manner of what origin, into acute, chronic, and cicatricial states. He believes that the acute cases are mostly of bacterial causation, and that the chronic ones are mostly constitutional. He states that dispensary treatment is totally inadequate in trachoma and that trachoma sanatoria should be created in all Mediterranean countries.

Phillips Thygeson.

Cosmettatos, G. F. **Melanosis of the lacrimal caruncle.** Folia Ophth. Orientalia, 1933, v. 1, Feb., pp. 182-187.

Cosmettatos distinguishes melanosis from pigmented nevus. He gives the histologic description of a case of melanosis of the caruncle in a person who did not show melanotic spots in other parts of the body. The author assumes for his case epithelial origin of the melanotic cells. At the end of the article he mentions a case of extensive melanosis of the conjunctiva and of the semilunar fold and also a case of mela-

nosis of the optic disc, both observed in his clinic at the University of Athens.

Phillips Thygeson.

Delanoë, E. **The treatment of trachoma with chaulmoogra oil.** Rev. Internat. du Trachome, 1933, v. 10, April, pp. 87-99.

The authoress states that chaulmoogra oil offers incontestable advantages over other medicaments in the treatment of trachoma, its use being painless and well tolerated, and rapidly resulting in cure when used in initial stages of the disease. It has a very rapid and favorable action against pannus.

Phillips Thygeson.

El-Tobgy, A. F. **Spring catarrh in Egypt.** Folia Ophth. Orientalia, 1933, v. 1, Feb., pp. 168-181.

El-Tobgy summarizes the current views regarding the etiology of this disease, which include autointoxication, infection, photochemical reaction, endocrine and metabolic disturbance, and allergy. He investigated the possibility of a microbic etiology but was unable to find any bacteria which could be considered significant either in films or cultures from the disease. Inoculation of monkeys with conjunctival tissue and secretion gave negative results.

Spring catarrh is very frequent in Egypt and the symptoms may be present at any season of the year. The disease is usually combined with trachoma. An analysis of 133 cases indicates that 36 percent are less than fifteen years old, 51.1 percent between fifteen and thirty years, 12 percent between thirty and forty years, and only one percent more than forty years. Males are affected in 79.9 percent of the cases and females in 20.3 percent. The palpebral type of the disease occurs in 71.4 percent, bulbar in 11.2 percent and mixed forms in 17.4 percent.

A number of specimens of tissue were examined histopathologically. The changes consisted mainly in the formation of epithelial pillars and nests, subepithelial fibrosis, and hyaline degeneration. Eosinophilic cells were seen infiltrating the tissue and passing through the epithelial layer. The cellular infiltration consisted mainly of lymphocytes and plasma cells. In spite of the local eosinophilia, no increased eosinophilia was found in the blood except in cases where parasitic infection or other known cause of eosinophilia coexisted.

The author discusses treatment in detail, including surgical measures, autohemotherapy, splenic extract, arsenic, calcium, ultraviolet light, lactic acid, chaulmoogra oil, and radium. Chaulmoogra oil appeared quite effective in the cases mixed with trachoma; radium produced satisfactory results in children and in cases with soft papillae.

Phillips Thygeson.

Esteban, M. **Peculiarities of conjunctival pathology in Morocco.** Folia Ophth. Orientalia, 1933, v. 1, Feb., pp. 218-227.

In Morocco ophthalmology presents certain characteristics peculiar to the country and to the mode of living of the indigenous population. Esteban describes some of the superstitions and medical practices used by the Moors in the treatment of conjunctival diseases. He reviews the subject of conjunctival pathology, in which, in Morocco, trachoma in its malignant form and Koch-Weeks conjunctivitis play the leading rôles. The latter occurs every summer in epidemic form. Scrofulous affections of the eye are uncommon, a fact attributed to the defective resistance of the natives to tuberculosis, which causes them to succumb before allergic symptoms are manifest. The author describes other forms of conjunctivitis, including a pseudomembranous variety apparently caused by a Gram-negative diplococcus morphologically identical with the gonococcus. Penetrating injuries of the globe are frequently due to the spines of "chumbos," a species of cactus. The spines stain well with methylene blue, and this facilitates their extraction. The author concludes with a discussion of ocular myiasis, for which he recommends application of calomel ointment after extraction of the larvae.

Phillips Thygeson.

Krishnaswami, C. V. **A conjunctival band simulating a persistent nictitating**

membrane. Brit. Jour. Ophth., 1933, v. 17, July, p. 417.

At the temporal side of the eyeball, a fold of conjunctiva from the inferior fornix was drawn up and adherent to a small area of the upper tarsal conjunctiva. The eyeball had perfect freedom of movement. The case was one of a series of five of similar character. Explanation was furnished by investigation of a number of cases of acute mucopurulent conjunctivitis with enormous swelling. The country treatment for "sore eyes" (Madura, India) is what is called "cutting the heat." The lower fornix is scarified with the rough under surface of a pumpkin leaf. This produces marked swelling of the lower fornical conjunctiva. Apparently in this manipulation the upper tarsal conjunctiva may be injured and the two surfaces become adherent, forming a cicatricial band. D. F. Harbridge.

Lavery, Francis. **Trachoma prophylaxis.** Irish Jour. Med. Science, 1933, Feb., p. 77.

The author urges prevention of epidemics of acute conjunctivitis because he believes them frequently causes of transference of trachoma and aggravation of the disease in those already mildly affected.

Ralph W. Danielson.

Lumbroso, U. **Tumors of the plica semilunaris.** Rassegna Ital. d'Ottal., 1933, v. 2, nos. 1-2, pp. 93-104.

Three cases of tumor of the plica are reported. The anatomico-pathological picture is that of diffuse infiltration by cells of the nevus type, nonpigmented, with proliferative reaction of the epithelium and formation of cystic glandular tubules. (Illustrated.)

Eugene M. Blake.

Morax, V. **Microbiologic etiology of trachoma.** Rev. Internat. du Trachome, 1933, v. 10, July, pp. 113-128.

This report was presented before the Fourteenth International Congress of Ophthalmology at Madrid in April, 1933.

Bacterioscopic study of trachoma follicles and of the secretions of pure trachoma has revealed no significant microorganism. The import of cytoplasmic inclusion bodies is discussed. This is not clearly established, but neither their presence in trachoma nor their parasitic nature is in doubt.

Phillips Thygeson.

Schousboë, F. **A study of the clinical appearances of incipient trachoma by means of graphs.** Rev. Internat. du Trachome, 1933, v. 10, Jan., pp. 4-20.

Schousboë analyzes the conjunctival and corneal findings in over one thousand cases of incipient trachoma in Algiers. Under limbal signs he considers (a) the infiltrative phase and (b) "ocellation limbique" or limbal follicles. The infiltration involves the upper third of the limbus and is accompanied by vascular loops derived from the conjunctival circulation. The limbal follicles are at first transparent and consist of small circular or oval elevations; they have been termed "ocelli" because of their resemblance to the eyes of insects. The follicles are arranged concentrically, usually in a single row, with the largest in the center. In early cases they are surrounded by a rich capillary plexus which is not present in older forms.

The author has attempted to analyze the frequency of the various signs of trachoma at various ages by means of graphs. Limbal infiltration is not seen before two years of age but at three years of age forty-two percent of the cases show infiltration and vascularization of the cornea. Limbal follicles are first seen at three years of age and reach a maximum at nine or ten years of age. Old cicatrized follicles may be recognized in seventy-five percent of the adults with trachoma and thus constitute the most important limbal sign of the disease. Conjunctival signs are more important in diagnosis of the disease before the age of three years, while after this the limbal signs become of greater value. Phillips Thygeson.

Sedan, J. **Results of the Tricoire intradermal test in one hundred and fifty cases of trachoma.** Rev. Internat. du Trachome, 1933, v. 10, July, pp. 145-154.

In nontrachomatous subjects the Tricoire reaction is negative in the immense majority of cases. Of 150 cases of florid trachoma it has been positive in 61.33 percent, doubtful in 16 percent, and negative in 22.67 percent.

The antigen is prepared by grinding the expressed granulations from cases of florid trachoma in ten times their volume of physiologic salt solution. They are then allowed to macerate in the incubator at 37°C. for fifteen days, after which the material is centrifuged and the supernatant fluid removed and retained. Two drops of tincture of iodin are then added for each ten cubic centimeters of liquid; after one-half hour the iodin is neutralized by one drop of a sterile solution of sodium hyposulphite. The test is made by injecting 0.25 c.c. intradermally, a control injection being made with a solution containing iodin and human serum, to eliminate false reactions. Phillips Thygeson.

Sjögren, H. **Keratoconjunctivitis sicca.** Acta Ophth., 1933, supplement 2.

This is a very complete monograph, illustrated with numerous microphotographs of conjunctiva, cornea, and lacrimal and salivary glands. This slowly progressive disease occurs mostly in middle-aged women and is resistant to treatment. The subjective symptoms are those of a chronic conjunctivitis, marked photophobia, absence of lacrimal secretion, and impaired vision.

There is a profuse mucous secretion in the conjunctival sac, threads of mucous fastened to the cornea, and wrinkling of and greyish infiltrates in the corneal epithelium. Patients may also suffer from diminished salivary secretion, decay of the teeth, and arthritis. Histologically there is chronic edema of the conjunctiva; moderate infiltration with plasma cells and eosinophiles; hyaline degeneration of the corneal epithelium with partial necrosis and exposure of Bowman's membrane; atrophy of the parenchyma of the lacrimal glands, which is replaced by connective tissue, with infiltration by round cells; and to a lesser degree similar changes in the salivary glands. The author considers this a constitutional affection, with predominance of ocular symptoms. He believes that the primary change is atrophy of the lacrimal glands. Ray K. Daily.

Smukler, M. E. **Cul-de-sac forceps.** Amer. Jour. Ophth., 1933, v. 16, July, p. 622.

Talbot. **Trachoma. Initial infection in the child and in the adult.** Rev. Internat. du Trachome, 1933, v. 10, Jan., pp. 42-45.

Talbot states that there is considerable difference in the clinical signs of trachoma according to whether it is contracted in infancy or in adult life. The disease in the infant tends to remain latent for several years whereas in the adult it often starts and continues with much inflammatory reaction. After the cicatricial stage the two conditions can no longer be differentiated.

Phillips Thygeson.

Thygeson, P. **The microbiologic etiology of trachoma.** Rev. Internat. du Trachome, 1933, v. 10, July, pp. 129-141.

In a report presented before the Fourteenth International Congress of Ophthalmology at Madrid in April, 1933, the author summarizes our present knowledge concerning the microbiology of trachoma. He feels that the communicability and specificity of trachoma have been established by both clinical and experimental observations and that a specific microorganism must be concerned in its etiology. Insufficient evidence has been advanced to establish Bacterium granulosis, or any other one of the fifteen microorganisms offered by previous investigators, as the etiologic agent of the disease. While a strong case has been built up for Bacterium granulosis on the basis of monkey experiments, it has not been shown to be constantly present in trachoma nor has it been shown by numerous inoculation experiments to be capable of producing trachoma in man. Moreover, the author advances evidence, obtained from transfer of the experimental Bacterium granulosis disease of monkeys to human eyes, which suggests that the monkey disease is a type of follicular conjunctivitis and not trachoma. The failure of

investigators over a period of fifty years to establish a bacterial cause for trachoma suggests that the agent may belong to the so-called filtrable viruses.
(Author's summary.)

Verhoeff, F. H., and King, M. J. **Leptotrichosis conjunctivae. (Parinaud's conjunctivitis.)** Arch. of Ophth., 1933, v. 9, May, pp. 701-714; also Trans. Amer. Ophth. Soc., 1932, v. 30, p. 131.

The authors here report four cases resembling those commonly known as Parinaud's conjunctivitis, from three of which they were able to grow the leptothrix in pure culture. Following animal inoculation, lesions were produced similar to those occurring in man, though no glandular enlargements were obtained. Direct smears from emulsions obtained from excised conjunctival lesions showed a few leptotriches. Growth could be started only on dextrose-serum-agar and serum-agar at 35 degrees C. in jars in which 10 percent of the air was replaced by carbon dioxide. After from three to six subcultures, however, the organism grew on most any medium and without addition of carbon dioxide to the air. The older and larger organisms were gram-negative and nonacid-fast. Spores appeared in fourteen days under aërobic conditions. Motility was present in forty-eight-hour serum-agar cultures, but gradually disappeared. Flagella could not be demonstrated. M. H. Post.

6. CORNEA AND SCLERA

Ballantyne, A. J. **"White rings" in the cornea.** Brit. Jour. Ophth., 1933, v. 17, June, p. 336.

After referring particularly to Coats' description the author reports four cases and in a postscript two subsequent cases. The rings were less than a millimeter in diameter, and were composed of chalky-white globular spots, which did not overlap or coalesce. The author is inclined to trace the condition to intraocular disease, although Coats suggested it might be congenital. In one of his cases there was a chronic type of retinochoroiditis, in another an acute exudative choroiditis, in a third an acute glaucoma. In the fourth case the fundi were normal. (Five illustrations.)
D. F. Harbridge.

Baratta, O. **The action of "leucocytic trephones" upon the cicatrization of corneal wounds.** Rassegna Ital. d'Ottal., 1933, v. 2, nos. 1-2, pp. 105-116.

Baratta conducted a series of experiments using leucocytic trephones (special nutrient substances found in embryonic tissue and more recently in leucocytes, lymphocytes, malignant tumors, muscular tissue, brain, kidney, and thyroid gland of adult animals) as a therapeutic agent in the healing of corneal wounds. He found that the reparative phenomena were more rapid in corneas treated with this substance, karyokinesis was more active, and epithelial cell proliferation was stimulated. The process of regression was accelerated and new connective tissue developed more actively in the cornea. (Illustrated.) Eugene M. Blake.

Busacca, A. **Frequency of corneal complications in trachoma.** Rev. Internat. du Trachome, 1933, v. 10, April, pp. 57-81.

The author has studied the corneal complications in one hundred cases of trachoma of various stages. By means of charts he indicates the types of complication in relation to the age of the patient and the stage of the disease.

Busacca divides pannus into incipient, active, and sclerotic, and describes the fundamental characteristics of each stage. His statistics show pannus in one form or another in over ninety-nine percent of trachomatous eyes examined. According to him the limbal follicles or their remains, known as Herbert's pits, are formed only at the limbus and never invade the cornea. They were found in eighty-seven percent of the cases. In addition he found an avascular keratitis preceding new vessel formation in sixty-two percent of the cases, and round isolated infiltrates having a marked disposition to ulcerate in twelve percent.

In the lower half of the cornea trachromatous complications were less frequent. Proliferation of vessels and in-

vasion of the superficial layers of the cornea were present in fifty-three percent, and limbal follicles or Herbert's pits in five percent.

The author concludes that pannus is a manifestation which accompanies trachoma constantly and appears early.

Phillips Thygeson.

Deutschmann, R. **Successful treatment of parenchymatous keratitis.** Klin. M. f. Augenh., 1933, v. 91, July, p. 101.

For years Deutschmann has had good results from the treatment of parenchymatous keratitis with scarlet-red salve eight percent once a day, combined with hot applications, syrup of iodide of iron, and atropin. If improvement stops, the scarlet red is discontinued for a fortnight and replaced by five percent airol salve. C. Zimmermann.

Doggart, J. H. **Derangement of the corneal nerves.** Brit. Jour. Ophth., 1933, v. 17, July, p. 385.

The author discusses herpes, recurrent corneal abrasion, corneal changes following influenza, corneal dystrophies, different types of keratitis, marginal degeneration of the cornea, and corneal disturbances in glaucoma. Most of these disorders are associated with lessened corneal sensation. Epithelial edema being the most characteristic early sign of disordered corneal nerve supply, it is necessary to consider the possibility of a nervous lesion in cases which persistently show this sign without rise of ocular tension, and in the absence of any obvious traumatic or inflammatory cause.

D. F. Harbridge.

Dunnavan, F. L., and Motto, M. P. **Kayser-Fleischer ring in Wilson's disease.** Amer. Jour. Ophth., 1933, v. 16, July, pp. 571-576.

Friede, R. **A case of total autokeratoplasty turning the flap 180°.** Klin. M. f. Augenh., 1933, v. 91, July, p. 75. (Ill.)

In the presence of a sufficiently large clear marginal zone, an old central scar of the cornea which does not clear up under treatment may be submitted to autoplasty, turning the flap 180°. In eight cases Friede obtained five clear healings. His technique is described in detail. Autoplasty is superior to homoplasty, since unfavorable reactions between the cornea of the donor and that of the receiver are eliminated.

C. Zimmermann.

Friede, R. **The necessity of preliminary operations for keratoplasty.** Klin. M. f. Augenh., 1933, v. 91, July, p. 87.

According to Friede the frequent failure of correctly performed keratoplasty is due to insufficient preparation of the cornea. Improvement may be obtained by increase of metabolism of the anterior segment, attempts at clearing of the cicatrized parts of the cornea bordering in the trephine area, and by other preliminary measures.

C. Zimmermann.

Groenouw. **Nodular opacities of the cornea inherited through four generations.** Klin. M. f. Augenh., 1933, v. 90, May, p. 578.

A man aged fifty-one years showed about fifty or sixty sharply circumscribed gray opacities in a central circular area under the epithelium of both corneas. After curetting the epithelium, vision rose from 1/5 to 2/5. He had been married twice and seven women of his descendants were affected. By his first marriage he had two diseased and one healthy daughter; and by the second marriage one diseased daughter, two healthy sons, and two healthy daughters. All seventeen persons of the third generation from the second marriage had healthy eyes. The first diseased daughter of the first marriage had four healthy children and seven healthy grandchildren. The second diseased daughter had two diseased daughters and a healthy son, who had healthy descendants. The older diseased daughter had a single diseased daughter who was the great granddaughter of the patient. The second diseased daughter had a diseased daughter and a healthy son of eight years who still may become affected. The remaining members of the fourth generation were healthy. The hereditary transmission was dominant

and aside from the patient only women were affected. C. Zimmermann.

Manes, A., and Jalour, I. R. **Treatment of serpiginous corneal ulcer.** Arch. de Oft. de Buenos Aires, 1932, v. 7. Oct., pp. 620-623.

The authors obtain good results in the treatment of serpiginous ulcers of the cornea by combining pasteurization, paracentesis of the anterior chamber, removal of the lacrimal sac, and protein therapy. R. Castroviejo.

Melo, Guedes de, Jr. **Maxillary sinusitis and trachoma.** Arquivos do Instituto Penido Burnier (Brazil), 1933, v. 1, March, pp. 152-164.

Fourteen maxillary sinuses were opened in the hope of relieving the severity of corneal trachoma. Of four cases in which the maxillary sinus was obviously diseased, the two in which the disease was on the same side as the more severe trachomatous process showed distinct improvement in the latter respect, while the other two showed no such improvement. None of the cases without manifest disease of the antrum was benefited by the antrum operation. The author is satisfied that the severity of corneal trachoma may be aggravated by neighboring disorders. W. H. Crisp.

Navarro Martin, A., and Diaz Caneja. **Biological treatment of ocular herpes.** Arch. de Oft. Hisp.-Amer., 1933, v. 33, June, p. 367.

On the basis of previous work by one of the writers demonstrating in herpes a state of allergy to intradermal injection of cerebral extract obtained from a rabbit inoculated with herpeto-encephalitic virus, attempts were made to desensitize four cases of herpes corneae and one case of nasopalpebral herpes. The results have been encouraging. The preparation used was an emulsion of rabbits' brains which had been inoculated with herpeto-encephalitic virus obtained from Levaditi's laboratory.
M. Davidson.

Rojas, F. A., and Dusseldorp, M. **Action of tonsillectomy in some cases of scrofulous keratitis.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Dec., pp. 707-710.

Tonsillectomy was performed in six cases of scrofulous keratitis. In four of these cases the local symptoms became worse from twelve to twenty-five days after the operation, but gradual improvement and permanent cure followed. In the other two cases there was recrudescence of the local symptoms.
R. Castroviejo.

Schappert-Kimmijsu, Johanna. **Relapsing erosion and familial degeneration of the cornea.** Klin. M. f. Augenh., 1933, v. 90, May, p. 655.

A boy, aged one year, suffered from spontaneously relapsing erosions of the cornea. His mother came from a family in which many were affected with nodular or lattice-shaped degeneration of the cornea. Further research showed in two generations of this family coincidence of these degenerations with relapsing erosion.
C. Zimmermann.

Schmidt, Rolf. **Striped superficial herpetic keratitis.** Klin. M. f. Augenh., 1933, v. 91, July, p. 47. (Ill.)

During an epidemic of herpetic corneal affections at the eye clinic at Freiburg in 1932, and in obvious connection with it, four cases of this rare complication were observed. The stripes consisted of parallel or crossed rectilinear changes in the corneal epithelium, never in the parenchyma, and were made up of very fine punctiform opacities stainable with fluorescein. There was more or less diminution of sensibility. In only one case was a traumatic basis established. The condition was treated with curettement and iodine.
C. Zimmermann.

Sjogren, H. **Keratoconjunctivitis sicca.** Acta Ophth., 1933, supplement 2. (See Section 5, Conjunctiva.)

Spitzer, Emma. **The question of corneal sensibility after certain retinal operations.** Graefe's Arch., 1933, v. 130, p. 42. (See Section 10, Retina and vitreous.)

7. UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Abramson, J. L., and Teitelbaum, M. H. **The Argyll Robertson phenomenon in multiple sclerosis.** Amer. Jour. Ophth., 1933, v. 16, Aug., p. 676.

Almeida, A. de. **Chronic uveitis.** Arquivos do Instituto Penido Burnier (Brazil), 1933, v. 1, March, pp. 90-126.

The author, who thinks that North Americans are placing less emphasis on focal infection than they did a few years ago, speaks of syphilis as the greatest factor in the occurrence of uveitis in Brazil. He relates a number of cases of ocular syphilis and tuberculosis, and adds a few of dental and sinus infection, as well as several cases of gonorrheal uveitis, a case of influenza uveitis, and a number of cases of sympathetic uveitis. Chronic uveitis he regards as produced by the action of toxins. W. H. Crisp.

Kurz, Jaromir. **Degenerative processes in the iris.** Oft. Sbornik, 1932, v. 7, pp. 116-130.

Of four cases, three were studied histologically.

Case one was a sixty-five-year-old male, with a highly myopic eye after recurrent attacks of iridocyclitis. The retina became detached, and after several quiet years secondary glaucoma developed, accompanied by masses of cholesterin crystals in the anterior chamber, vitreous, and subretinal fluid, and fat in the iris.

Case two was in a male aged twenty-seven years, from whose right eye an intraocular iron chip had been removed ten years earlier. Recurrent iridocyclitis was followed by total retinal detachment. The anterior chamber had many cholesterin crystals. The iris macroscopically showed no fatty degeneration. Histological study was not made.

In case three a female aged fifty-nine years had an advanced stage of xanthomatosis of the iris in an eye blinded by primary glaucoma.

In case 4 a female aged forty-five years developed secondary glaucoma in a right eye blind from birth, probably from intrauterine uveitis. In the degenerated iris were chalk-white calcium nodules. According to the author, the cholesterin crystals are not due to increase of cholesterin in the blood but to disturbed local metabolism.

Georgiana D. Theobald.

Lagrange, Henri. **Iridociliary tuberculosis.** Ann. d'Ocul., 1933, v. 170, July, pp. 561-571.

After reviewing the subject for report to the Fourteenth International Congress of Ophthalmology the author presents the problem of diagnosis. Besides general evidence of tuberculosis, and the morphology of the eye, may be included findings with tuberculin, by guinea pig inoculation, and the microleucocytoculture of Löwenstein.

H. Rommel Hildreth.

Uribe Troncoso, M. **The continuous circulation of the aqueous humor.** Amer. Jour. Ophth., 1933, v. 16, Aug., p. 669.

Weskamp, R. L. **Bilateral exudative uveitis with poliosis, alopecia, dysacusis, and retinal detachment.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Dec., pp. 728-741.

This is a case of bilateral exudative choroiditis with alopecia, considerable diminution of hearing and vision, graying of hair and eyelashes, and retinal detachment, which spontaneously reattached itself with marked improvement of vision in spite of such profound changes. This syndrome was apparently due to traumatism, but the Wassermann was found to be four plus, and antiluetic treatment with mercury was thought responsible for cure. The author reviews similar cases and discusses the theories of etiology and pathogenesis. (Photograph and bibliography.)

R. Castroviejo.

8. GLAUCOMA AND OCULAR TENSION

Franta, Jiri. **Interchange of tissue fluids in primary glaucoma.** Oft. Sbornik, 1932, v. 7, pp. 223-237.

The course of sodium chloride metabolism was observed in eighteen patients with primary glaucoma (simple chronic and acute or chronic inflammatory). In

every case there was more or less retention of water and sodium chloride. The rhythm of secretion and the changes of sodium chloride level in the blood serum also showed certain deviations. Georgiana D. Theobald.

Fuchs, Adalbert. **Advances in the operative treatment of acute glaucoma (iridectomia ab externo).** Ars Medici (Jour. Amer. Med. Assoc. of Vienna), 1933, v. 11, April, p. 147.

Fuchs recommends this operation as painless, simple, and easy, and without danger of injuring the lens or of expulsive hemorrhage. He recommends venesection before operating on cases of glaucoma. A broad conjunctival fold is prepared as in Elliot's trephining. The incision through the sclerotic is accomplished by scratching back and forth 1 mm. behind and concentrically with the limbus for about 7 mm., using the tip of the keratome lance. Then the sclerotic is perforated at one spot. A small prolapse of the iris results. A drop of cocain is placed on the prolapsed iris, the sclerotic wound is widened. No instrument is introduced into the eye. After instilling a few more drops of cocain, the iris prolapse is grasped, drawn forward and to the side, and excised with several clips of the de Wecker scissors. In this procedure the iris must be drawn forward fairly energetically. Reposition of the iris is obtained by massaging the edges of the wound with the spatula. (One case report and much discussion.)

Ralph W. Danielson.

Kronfeld, P. C. **Anterior chamber punctures in relation to intraocular tension.** Arch. of Ophth., 1933, v. 9, May, pp. 801-816.

This paper defends the author's position stated in 1930 that reactive hypertony after anterior chamber puncture (beyond that of the nonglaucomatous eye) "is a consistent and essential symptom of eyes affected with simple glaucoma", a symptom even more characteristic than the intraocular tension.

A number of cases are recorded to show that anterior chamber puncture is of value as a provocative test for diagnosis of early or latent glaucoma.

M. H. Post.

O'Brien, C. S., and Porter, W. C. **Glaucoma and nevus flammeus.** Arch. of Ophth., 1933, v. 9, May, pp. 715-728.

Stasis of blood resulting from the nevoid, angiomatous or vascular changes in the eye and adnexa produces increase in intraocular pressure, of the infantile type. Associated vascular lesions have been found in iris, choroid, retina, conjunctiva, and elsewhere; nevus or angioma of the meninges having been found frequently. Hemiplegia, epilepsy, convulsions, and homonymous hemianopsia have also been observed.

M. H. Post.

9. CRYSTALLINE LENS

Abramowicz, I. **Superficial coronary striated opacification of the crystalline lens.** Ann. d'Ocul., 1933, v. 170, July, pp. 602-604.

The luminous opacity seemingly lay superficially in the anterior cortex and was about 8 mm. in diameter. It could be seen only with a certain adjustment of the slitlamp and seemed to be related to the iris, for in one case the ring was complete in both eyes except behind an iridectomy coloboma of one eye. Of 271 cases seen routinely the condition was found in 90 percent.

H. Rommel Hildreth.

Adrogue, E., and Gallino, J. A. **Posterior lenticonus, partial coloboma, and abundant precipitates on the posterior lens surface.** Arch. de Oft. de Buenos Aires, 1932, v. 7. Oct., pp. 598-602.

Abundant deposits of pigment were found on the posterior surface of the lens, and also a partial coloboma of the lens toward the temporal side. (Bibliography.) R. Castroviejo.

Clark, Coral. **Entoptic phenomena observed in my eyes before and after cataract operations.** Amer. Jour. Ophth., 1933, v. 16, Aug., p. 706.

Cusumano, A. **Concerning expulsive hemorrhage after operation for cataract.** Arch. di Ottal., 1933, v. 40, March, pp. 129.

Expulsive hemorrhage occurred in a woman sixty-four years of age, ten hours after operation for cataract. The author explains such phenomena on the basis of stimuli projected reflexly through the vagus and sympathetic systems. Herman D. Scarney.

Foster, J. **The identity of cataract formations.** Brit. Jour. Ophth., 1933, v. 17, July, p. 408.

The author classifies lens opacities in relation to their location by means of the slitlamp. Under congenital he refers to anterior and posterior polar, appearing as solid chalk-white opacities usually axial, at times of collar-stud shape, or presenting tiny regularly spaced white dots concentrated at the zone marking the surface of the fetal nucleus. Complicated cataract, associated with retinitis pigmentosa, iridocyclitis, or other disorders, presents early a polychromatic luster at the posterior zone, with faint flaky opacities in the posterior polar cortex. Heat cataract is a disc-shaped opacity situated in the axial posterior layers. Traumatic cataract appears as a "rosette" in the posterior cortex, with a dead white reflex. Cataracts due to glandular dyscrasia are of two types, the diabetic, presenting small cloudy opacities situated anteriorly and posteriorly under the lens epithelium; and the cortical, caused by any of several diseases.

D. F. Harbridge.

Lech, Junior. **Surgery of senile cataract.** Arquivos do Instituto Penido Burnier (Brazil), 1933, v. 1, March, pp. 141-151.

The technique recommended by the author includes akinesia, corneoscleral suture, capsulectomy, but not iridectomy. He claims ninety-eight percent of cases with restored vision.

W. H. Crisp.

Mans, R. **Pigmented secondary cataract.** Klin. M. f. Augenh., 1933, v. 90, May, p. 650. (Ill.)

Eighteen years previously the patient had sustained contusion cataract with capsule rupture from a whip injury. At the time of presentation the whole pupillary area was occupied by a pigmented secondary cataract. After two weeks the patient died from pulmonary gangrene and the eye was immediately enucleated. Microscopical examination revealed that pigment proliferation started from the pigment layer of the iris at an injured place in the pupillary margin. C. Zimmermann.

Szily, A. **Adipose epithelial dystrophy of the lens.** Klin. M. f. Augenh., 1933, v. 90, May, p. 607. (Ill.)

A man aged fifty-nine years presented circumscribed progressing anterior polar cataract, with innumerable cholesterine crystals and with fatty degeneration of the opaque zones in the otherwise clear lens. The degree of hypercholesterinemia was perhaps too slight to be the chief cause of the dystrophy. C. Zimmermann.

Vogt, Alfred. **Further researches to measure the intensity of visible radiation of the glass furnace. With remarks on the alleged significance of this radiation for glassmaker's cataract.** Klin. M. f. Augenh., 1933, v. 91, July, p. 30. (Ill.)

The author's spectral measurements at the Bülach glass furnace in 1930 proved that the visible and ultraviolet radiations of the glowing mass of glass were minimal in comparison with the ultrared. Further measurements show that the radiation of the mass of glass contains visible and ultraviolet light of extremely weaker intensity than ordinary diffuse daylight. The protective and cooling apparatus of the eye, that is the lids, the conjunctiva with its lacrimal fluid, the iris, and so on, prevent any thermal damage of these media, but do not prevent penetration of the ultrared through the cornea into the avascular lens, where the radiation produces cataract although cornea and iris remain intact. C. Zimmermann.

10. RETINA AND VITREOUS

Abramowicz, I., and Dulevicz, M. **The ocular fundus in a case of acute lupus erythematodes (erythema perstans).** Ann. d'Ocul., 1933, v. 170, July, pp. 599-602.

The patient, a thirty-three-year-old woman, was pregnant. Edema and red-

ness involved the face and upper parts of the body. There was no improvement after delivery but the edema did vary in degree, with similar variations in the fundus lesion. The maculas were dotted with minute light nonpigmented bodies. The periphery and vessels were normal. The appearance somewhat resembled guttate retinititis. The vision was normal. H. Rommel Hildreth.

Adrogue, E., and Seña, J. **Two cases of hole at the macula.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Nov., pp. 652-659.

One resulted from traumatism and the other from hemorrhage due to retinal venous thrombosis.

R. Castroviejo.

Arruga, H. **The difficulties of finding retinal tears.** Klin. M. f. Augenh., 1933, v. 90, June, p. 753. (Ill.)

These difficulties are: small size, opacities of the media, similarity to hemorrhages, location in retinal fold, and extremely peripheral location.

C. Zimmermann.

Bartels, M. **Further observations on operations for detachment of the retina according to Guist and Weve.** Klin. M. f. Augenh., 1933, v. 90, June, p. 800.

General constitutional elements, age, and sex play a very important part in the Guist operation. Why in some cases one does not succeed in bringing the detached retina in contact with the cauterized spot in the choroid is unknown.

C. Zimmermann.

Courtis, B., and Gavioli, R. L. **Ocular lesions of pregnancy.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Aug., pp. 463-474.

Retinal detachment occurred in a patient with chronic nephritis and superimposed gravidic nephropathy.

R. Castroviejo.

Damel, C. S. **Acquired anophthalmia and permanent disfiguration of the face.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Dec., pp. 718-737. (See Amer. Jour. Ophth., 1933, v. 16, March, p. 284.)

Goerlitz, M. **Experience with operative treatment of retinal detachment.** Klin. M. f. Augenh., 1933, v. 91, July, p. 1. (Ill.)

Goerlitz reports his experience with the operations of Gonin, Sourdille, and Weve. He is convinced that with exact observation of Gonin's directions after localization of the tear there is no reason to abandon his method in favor of the more recent operations.

C. Zimmermann.

Gonin, J. **Preliminary measures in the surgical treatment of detachment of the retina.** Ann. d'Ocul., 1933, v. 170, June, pp. 525-532.

The author reviews some details of former papers. He insists upon accurate localization of the tear and suggests marking its meridian on the limbus with a drop of India ink. As to bed rest before operation, in some cases of detachment above he feels that the vertical position is best.

H. Rommel Hildreth.

Guist, Gustav. **Operation for detachment of the retina with caustic potash, and its further development.** Klin. M. f. Augenh., 1933, v. 90, June, p. 771. (Ill.)

For a successful operation a freely movable retina is the basic condition. If the retina has no possibility of flattening out, any operative procedure is purposeless. This possibility may be studied by the behavior of the detached retina in a recumbent position of the patient. Knowledge of the anatomical and physical conditions of the retina, vitreous body, and sclera is necessary. The condition of the choroid is of minor importance. Also discussed are the influence of the vitreous upon the detachment, time and technique of operation, closure of holes at the fovea and of large flap tears. According to Guist's experience up to eighty-five percent of cases of detachment of the retina can be cured with caustic potash.

C. Zimmermann.

Jeandelize, P., and Baudot, R. **Aspects of retinal tears without appreciable detachment.** Ann. d'Ocul., 1933, v. 170, June, pp. 515-524.

Colored drawings illustrate six cases showing different types of tears. For surgical intervention in retinal detachment three principles are to be observed: First, the tear must be obliterated, the Gonin rule; second, the entire surface of the detachment must be reattached, the Sourdille rule; third, the macula must be protected by limiting the progress of the detachment, the Lindner rule.

H. Rommel Hildreth.

Levitt, J. M. **Recurrent vitreous hemorrhage.** Amer. Jour. Ophth., 1933, v. 16, Aug., p. 693.

Lindner, K. **Further experiences with the undermining method in retinal detachment with retinal holes at the posterior pole of the eye.** Klin. M. f. Augenh., 1933, v. 90, June, p. 757. (Ill.)

Clinical histories of nine cases are given. The undermining method devised by Lindner in 1931 is the most successful in this type of detachment. Seven of the nine were perfectly cured.

C. Zimmermann.

Maddox, Kemson. **The retina in hemochromatosis.** Brit. Jour. Ophth., 1933, v. 17, July, p. 393.

Hemochromatosis consists of an extraordinary derangement of liver and possibly of pancreatic metabolism, wherein excessive deposits of iron and copper are laid down in almost all organs and tissues, including the ectodermal structures. The picture produced is of diabetes mellitus accompanied by a slaty-blue discoloration of the skin, prompting the appellation "bronze diabetes". The author was unable to find in the literature any reference to retinal pigmentation, but in a study of four examples of this disease retinal pigmentary changes were discovered. The pigment was of a diffuse and uniform character concentrated more particularly around the disc, and fading off into normal retina in the periphery. It is surmised that the pigment is hemofuscin. (One microphotograph.)

D. F. Harbridge.

Manes, A. J. **Comments on intracapsular cataract extraction by the Stanculeanu-Török-Elschnig method.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Nov., pp. 660-665.

The author has operated upon more than four hundred cataracts by the Stanculeanu-Török-Elschnig method, and discusses briefly the most important details of the operation as well as some of the most frequent complications.

R. Castroviejo.

Manes, A. J. **Detachment of the retina.** Arch. de Oft. de Buenos Aires, 1932, v. 7. Dec., pp. 742-746.

The author emphasizes the importance of wearing stenopeic glasses as soon as a detachment of the retina is diagnosed, in order to prevent retinal rupture due, according to the theory of William Lister, to traction of the vitreous upon the retina in rapid movement of the eyes. R. Castroviejo.

Meighan, S. S. **Treatment of retinitis pigmentosa by cervical sympathectomy; preliminary report of a case.** Trans. Ophth. Soc. United Kingdom, 1931, v. 51, pp. 124-139.

The author removed the left superior and middle cervical ganglia of a twenty-year-old youth who had typical retinitis pigmentosa. In the right eye the fields improved from the 10° to the 15° circle and in the left eye to over 15°, in three months. Central vision also improved slightly but the author ascribes this to operative miosis. No noticeable difference was found in the caliber of the vessels of the two eyes. In discussion Lister suggested that the increase in size of fields might be due to education of the patient in field-taking.

Thomas D. Allen.

Sallmann, L., and Sveinsson. K. **Visual acuity and visual field in operatively healed retinal detachment.** Graefe's Arch., 1933, v. 130, p. 1.

The authors review the results as to central vision and visual field after successful operations in 101 cases (103 eyes) at the II University Eye Clinic in Vienna. The operative methods employed were Gonin's cautery puncture, Guist's caustic method, and Lindner's undermining procedure. Central visual

acuity after successful operation depended principally upon the duration of the disease. If less than three months, one could expect a good permanent visual result. Yet vision of from 6/18 to 6/36 was not infrequent after from five to eleven months duration of the detachment. Apart from duration, the prognosis for vision was in general more favorable when the vision before operation had not been less than counting fingers. Dense vitreous opacities occurred most frequently after cautery puncture, least often after the undermining method. H. D. Lamb.

Shapland, C. **An analysis of one hundred cases of retinal detachment treated by cautery puncture.** Trans. Ophth. Soc. United Kingdom, 1931, v. 51, pp. 152-169.

This reviews the results obtained in the first one hundred cases treated by Gonin's method at Moorfields Eye Hospital. The author classifies the cases according to type of retinal hole into five groups: (1) festoon shaped, the so-called "disinsertion" at the ora; (2) round holes; (3) arrow-shaped or horseshoe shaped rents; (4) radial-slit tears, and (5) irregular rents. He also certifies them according to position in the retina and according to refractive errors, and gives the final results of operative procedure. (Illustrations and fields.) Thomas D. Allen.

Spitzer, Emma. **The question of corneal sensibility after certain retinal operations.** Graefe's Arch., 1933, v. 130, p. 42.

The condition of the sensibility of the cornea was studied in thirty-nine eyes operated upon for retinal detachment by Guist's caustic potash method, in thirteen eyes operated upon by Lindner's undermining method, and in six eyes by diathermic acupuncture. In the first two operations, the caustic employed injured the ciliary nerves in the suprachoroidal space. Guist's method of cauterization of the choroid with solid caustic potash after trephining the sclera produced loss of sensibility in a more extensive sector of the cornea than Lindner's method, in which 0.01 c. c. of three to four percent solution of potassium hydroxide was injected into the subchoroidal space between every two trephine openings in the sclera. Definite signs of return of corneal sensibility after Guist's operation were noted in about five months. Complete recovery required another six months. After Lindner's undermining procedure, a definite improvement of the less injured sensibility began after three months, and was normal after five months in a single case kept under observation. Corneal sensibility suffered least when diathermy was employed. Small marginal ulcers occurred in the horizontal meridian after Guist's method and after diathermy. These ulcers usually healed after a long time without permanent changes. H. D. Lamb.

Szily, A., and Machemer, H. **Comparative investigations on the action of the different operative methods for retinal detachment in experiments on rabbits.** Klin. M. f. Augenh., 1933, v. 90, June, p. 806. (Ill.)

The experiments, described in detail, indicate that in all methods the quantitative element of dosage is of decisive importance, so that each can develop its possibilities only in the hands of experts. But even with appropriate dosage it is not always possible to exclude undesirable complications which make these operations serious procedures. Preparatory study of any method by animal experimentation is therefore emphatically urged. C. Zimmermann.

Wagener, H. P., Barker, N. W., and Burke, C. F. **Acute angiospastic retinitis: occurrence in cases of severe hypertensive and renal disease.** Amer. Jour. Med. Sciences, 1933, v. 175, April, p. 517.

The authors give five detailed case reports of young individuals and conclude that acute diffuse angiospastic retinitis may occur in both glomerulonephritis and primary hypertensive disease. The course of the retinitis and its associated arteriolar lesions will often indicate the degree of organic injury to the systemic arterioles. The retinitis is of serious

prognostic significance. (Five references.) Ralph W. Danielson.

Weskamp, R. L. **Bilateral exudative uveitis with poliosis, alopecia, dysacusis, and retinal detachment.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Dec., pp. 728-741. (See Section 7, Uveal tract, sympathetic disease, and aqueous humor.)

11. OPTIC NERVE AND TOXIC AMBLYOPIAS

Belgeri, F., and Valda Arana, R. **A case of papilledema with exophthalmos of unusual development.** Arch. de Oft. de Buenos Aires, 1932, v. 7, Dec., pp. 711-717. (See Amer. Jour. Ophth., 1933, v. 16, Feb., p. 183.)

Holloway, T. B. **Leber's disease.** Arch. of Ophth., 1933, v. 9, May, pp. 789-800.

The author reports three cases, and stresses considering the possible presence of this disease before undertaking intracranial operation for optic atrophy. Reference is made to Rehsteiner's pathologic findings in a patient seven years after onset of the disease.

M. H. Post.

Koutseff, André. **Optochin amaurosis.** Ann. d'Ocul., 1933, v. 170, July, pp. 583-589.

An infant fourteen months old with empyema was treated by draining the pleural cavity and injecting optochin. The pupils were soon found to be widely dilated and irresponsive to light, the discs pale, and the arteries very narrow. After a year the child could recognize small objects, but the fundus remained unchanged, with pale discs and fine arteries. H. Rommel Hildreth.

Lacroix, A. **Trivalent and pentavalent arsenicals and the optic nerve.** Ann. d'Ocul., 1933, v. 170, July, pp. 572-582.

The trivalent arsenicals such as Ehrlich's 606 and 914 are most effective in the early stages of syphilis and have little nerve toxicity. The pentavalent arsenicals such as stovarsol and tryparsamide have a selective action on the nervous system, being most effective in parenchymatous neurosyphilis, but they are also very toxic to the optic nerve. This second group must be used cautiously, under the indications of the visual field and of the development of central scotomata. In general the arsenicals are contraindicated in the presence of a bad systemic condition, especially as regards kidneys, hemorrhagic conditions such as purpura, and states of sensitivity or anaphylaxis.

H. Rommel Hildreth.

12. VISUAL TRACTS AND CENTERS

Alonso, A. F. **Traumatic lesion of the cortical center of vision. Anatomophysiologic considerations.** Anal. Soc. Mexicana de Oft. y Oto-Rino-Laring., 1932, v. 9, July-Dec., p. 186.

After a general consideration of the visual paths and centers in the brain, a case record is given. A man of twenty-eight years received a pistol shot, the bullet passing from near the angle of the mandible to below the external occipital protuberance. The ocular fundi were normal, the pupillary reactions normal, and visual acuity normal in each eye. The visual fields were almost completely lost, the blind area reaching almost to the fixation point below, but a width of about fifteen degrees being retained above, in each eye. The patient was able to write, although slowly, and visual memory was excellent. Radiography showed the foreign body to be situated intracranially to the left of the median line and well backward.

W. H. Crisp.

Bahn, G. **The difference in pupillary reaction of the temporal and nasal retina.** Acta Ophth., 1933, v. 11, Nos. 1-2, p. 190.

With apparatus consisting of two lamps movable in a semicircle, the author studied quantitatively the direct and consensual pupillary reactions of the temporal and nasal halves of the retina. He corroborates Hess' finding that the nasal halves are more sensitive than the temporal. This explains the anisocoria of homonymous hemianopsia, the pupil being larger on the side of the hemianopsia because the nasal (more sensitive) half of the retina is irresponsive. Ray K. Daily.

Black, G. H. B. **A case of intracranial aneurism with ocular signs.** Med. Jour. Australia, 1933, April 8, p. 434.

An aneurism in the prechiasmal space produced a marked nasal defect in the field of vision of the left eye. The author explains this unexpected finding by supposing that the left anterior cerebral artery was pulled against the outer side of the nerve. Fields of vision are given.
Ralph W. Danielson.

Boschi, G., and Campailla, G. **Cavernous sinus syndrome from adenoma of the hypophysis.** Riv. Oto-Neuro-Oft., 1932, v. 9, July-Aug. (issued May, 1933), pp. 414-421.

A man forty-seven years of age showed marked right exophthalmos, bilateral lid edema, and congestion of the conjunctiva more marked on the temporal side. Radiography of the skull showed an enlarged sella, and lumbar puncture a high spinal pressure. These symptoms gradually disappeared after depressive radiotherapy and the patient is still well, almost nine years after the treatment. The authors conclude that a tumor of the hypophysis, probably adenoma compressing the cavernous sinus, was the cause of the ocular symptoms. They also conclude that among the special syndromes of hypophyseal tumors there is a pure syndrome of the cavernous sinus, manifesting itself with the ocular triad as above mentioned and without trigeminal neuralgia or ocular paralysis. Melchiore Lombardo.

Campailla, G. **Hypophyseal adenoma and extensive focal syndrome without hemianopsia. Riv. Oto-Neuro-Oft.,** 1932, v. 9, July-Aug. (issued May, 1933), pp. 460-681.

A woman of forty-nine years, obese for many years, had recently suffered from daily frontal headaches, drowsiness and paraparesis. The eye symptoms were horizontal nystagmus, paralysis of the left external rectus, and anesthesia of the left cornea. Radiography showed enlargement of the sella. The patient improved under roentgen radiation. On the basis of left auricular and labyrinthine and trigeminal findings, compression of the left abducens, and other symptoms, the authors conclude that the patient had an adenoma of the median fossa expanding mostly to the left and originating from the hypophysis. (Bibliography and three figures.) Melchiore Lombardo.

Caramazza, F. **Chiasmal syndrome from atheromatous internal carotid artery. Riv. Oto-Neuro-Oft.,** 1932, v. 9, July-Aug. (issued May, 1933), pp. 486-515.

A woman seventy-two years old, affected by general arteriosclerosis and hypertension, had defective vision in both eyes, binasal hemianopsia, and central scotoma for colors. Both discs were pale. Radiography showed on both sides of the sella a linear opacity which followed the course of the internal carotid. A man sixty years old had the same general symptoms, defective vision in both eyes, central scotoma for colors, normal right field, and left nasal hemianopsia. Both discs were pale. Radiography showed at the left side of the sella an opacity which by its location, course, and other signs appeared to be the calcified internal carotid artery. The right internal carotid appeared calcified in its upper wall. The author concludes that the symptoms in the right eye were due to a concomitant polysinusitis. Radiographic findings are of a decisive importance in determining whether symptoms are due to atheromatous changes in the internal carotid. (Bibliography and sixteen figures.)
Melchiore Lombardo.

Charlin, Carlos. **Simulation and ocular hysteria.** Amer. Jour. Ophth., 1933, v. 16, Aug., p. 683.

Franceschetti, A. **The syndrome of internal carotid aneurism.** Riv. Oto-Neuro-Oft., 1932, v. 9, July-Aug. (issued May, 1933), pp. 482-485.

A young woman had recurrent attacks of headache followed first by right ptosis, then by right total oculomotor paralysis, and finally by left hemiplegia. Syncope preceded the paralysis, which occurred at a menstrual period. Lumbar puncture showed bloody fluid and increased pressure.

Post-mortem examination disclosed a hemorrhagic mass between the brain and the right sylvian fossa. The right internal carotid was larger than the left and showed a ruptured aneurism near the origin of the posterior communicating artery. The right third nerve appeared to be almost entirely destroyed by the hemorrhage. The rest of the central vascular system was normal.

Melchiore Lombardo.

Fuchs, A. **Minimal permanent ring scotomas after traffic accidents and paracentral scotoma after electric ear test.** Klin. M. f. Augenh., 1933, v. 91, July, p. 20.

An aviator of thirty years, who fell with his aëroplane, sustained a lacerated and contused wound of the forehead and noticed two days later a positive absolute ring scotoma in the right eye. The fundus appeared normal, but in red-free light the fovea was less yellow and presented three small whitish spots. After five weeks vision was 5/4 and the fundus normal. In a similar case in a man aged twenty-five years a minimal ring scotoma was observed after contusion of the head by a fall from an automobile. Thirdly, a man aged fifty years felt during an electric ear test a shock and an intense light sensation, which was followed by a small central scotoma in the left eye; so that caution is urged in these tests. C. Zimmermann.

Globus, J. H. **Tumors affecting the optic chiasm and optic tracts.** Arch. of Ophth., 1933, v. 9, May, pp. 729-750.

The visual lesions are grouped into syndromes as follows: (1) prechiasmal; (2) chiasmal, divided into suprasellar and intrasellar; (3) temporal lobe; (4) occipital lobe; (5) quadrigeminal body. Cases illustrate each group. The author argues the safety of surgical intervention and its justification. M. H. Post.

Koller, F. **The subsequent changes in thrombophlebitis of the cavernous sinus.** Graefe's Arch., 1933, v. 130, p. 64.

The changes at autopsy and microscopic findings are described in seven cases of thrombosis of the cavernous sinus. The source of the infection in five cases was furuncle of the face, in one case a general septic affection and in one case a peritonsillar abscess. In all the cases arising from furuncle the microorganism was culturally demonstrated to be staphylococcus aureus. In four cases an embolic pneumonia was found. In six cases there was infiltration of the internal carotid wall leading to thrombosis. In three of the six cases where both cavernous sinuses were examined, both internal carotids were thrombosed. In one case there was inflammatory involvement of the nerves passing through the sinus, particularly the abducens, the entire nerve being saturated with pus cells.

H. D. Lamb.

Magitot, A. **Crossed oculobulbar reactions.** Ann. d'Ocul., 1933, v. 170, June, pp. 465-502.

A stimulus to one eye may affect the fellow eye by causing a physical, chemical, or trophic response. Several graphs, from experimental and clinical studies, illustrate the curves of tension in the two eyes following different forms of trauma to one eye. A different type is the change in vascularity of the iris seen under the slitlamp as light plays on the other iris. The author suggests that these vasomotor phenomena may be explained by crossed nerve pathways.

R. Rommel Hildreth.

Thiel, R. **Cases and therapy of tumors of the hypophysis.** Klin. M. f. Augenh., 1933, v. 90, May, p. 581.

Observation of patients for years has proved visual field changes the best criterion. Five clinical histories are presented. As symptom of incipient pressure, Thiel found atrophic enlargement and deepening of the physiologic cup, sometimes strikingly different in the two discs. Twenty-three patients were treated with roentgen rays, five successfully. Progressive failure of the visual field and beginning atrophy of the optic nerve are absolute indications for operation. Two cases in which radium was introduced into the sphenoidal sinus could be considered cured, the improvement of vision and visual fields having lasted six and twelve years respectively.

Radiation after hypophyseal puncture, which produces a loosening of the tumor, gives better results. Introduction of thorium X by hypophyseal puncture into the tumor seems even more effectual. C. Zimmermann.

Verzella, M. **Changes in the visual field four years after radium treatment of hypophyseal tumor.** Riv. Oto-Neuro-Oft., 1932, v. 9, July-Aug. (issued May, 1933), pp. 452-459.

A man of forty-two years had shown, when first examined four years before, marked reduction of vision of both eyes, positive Wernicke, central scotoma for colors, bitemporal hemianopsia, and absence of the upper inner quadrant of each visual field. The sella was enlarged. A diagnosis of tumor of the hypophysis was made. After x-ray treatment achromatic vision in two symmetric sectors of the upper inner quadrant was noted. The author is of the opinion that this improvement was due to regression of the tumor and release from the counterpressure exerted on the dorsal area of the chiasm and its external borders by the anterior cerebral arteries. (Five figures, bibliography.)

Melchiore Lombardo.

Vicenzetto, C. **Four cases of probable adenoma of the hypophysis treated by radium with good results.** Riv. Oto-Neuro-Oft., 1932, v. 9, July-Aug. (issued May, 1933), pp. 516-530.

Enlargement of the sella and increased pressure on lumbar puncture were common to all four cases, which represent, however, three different symptomatologic types of the hypophyseal tumors. The first case showed a tuberian syndrome; a man twenty years old had, among other symptoms, marked drowsiness, psychic torpor, and superior hemianopsia. Two cases showed a chiasmal syndrome; a young woman was affected by recurrent headache, marked defect of vision, and bilateral hemianopsia; and a woman of forty-two years had atrophy of the nasal side of each disc, marked reduction of sight, and bitemporal hemianopsia. The fourth patient, a boy of fifteen years, showed the adiposogenital syndrome; with reduction of vision, papilledema of both eyes, and concentric contraction of the visual field. All improved under radium treatment. (Bibliography, sixteen figures.)

Melchiore Lombardo.

13. EYEBALL AND ORBIT

Hartleib. **Critical considerations on gigantophthalmos.** Klin. M. f. Augenh., 1933, v. 90, May, p. 620, (Ill.)

In a previously described case of unilateral megalocornea (Klin. M. f. Augenh., 1931, v. 87, p. 654) Hartleib suggested the possibility of gigantophthalmos, which from further considerations he now regards as a fact.

C. Zimmermann.

Kayser, B. **Normal size of eyeball behind megalocornea.** Klin. M. f. Augenh., 1933, v. 90, May, p. 626.

Kayser concludes that a normal eyeball usually lies behind the megalocornea. Gigantophthalmos is excluded and megalophthalmos questionable.

C. Zimmermann.

López Abadia. **A contribution to the study of the treatment of cavernous sinus thrombosis.** Arch. de Oft. Hisp.-Amer., 1933, v. 33, June, p. 375.

Since February, 1931, the writer has successfully treated four cases of cavernous sinus thrombosis with polyvalent antistreptococcic serum. One case followed tonsillitis, another a dacryocystorhinostomy, the third an orbital abscess, and the fourth a furuncle of the nasolabial fold. The writer is opposed to early incision except in the presence of intraorbital abscess.

M. Davidson.

NEWS ITEMS

News items in this issue were received from Dr. Henry N. Blum, New Orleans; Drs. Joseph I. Pascal, James W. Smith and M. Uribe Troncoso, New York City. News items should reach **Dr. Melville Black, 424 Metropolitan Building, Denver,** by the twelfth of the month.

Deaths

Dr. Henry William Lyding, New York; aged fifty years, died suddenly, July 16, of heart disease.

Dr. Webster Fels Keller, Los Angeles; aged forty-four years, died, June 25, of bronchopneumonia.

Dr. Charles E. H. Armbruster, Denver; aged sixty-five years, died, July 22, following an operation for appendicitis.

Societies

The following have been elected to office in the Cleveland Ophthalmological club for the coming year: President, Dr. Webb P. Chamberlain; Secretary, Dr. A. D. Ruedemann.

Officers elected to the Western Ophthalmological Society were: President, Dr. John E. Weeks, Portland; Vice President and Chairman of the Council, Dr. Edward Jackson, Denver; Secretary-Treasurer, Dr. Andrew J. Browning, Portland. Additional members of the Council: Drs. Hans Barkan, San Francisco; W. H. Roberts, Pasadena; Walter F. Hoffman, Seattle; Edward Leher, Salt Lake City.

Miscellaneous

The Harlem Eye and Ear Hospital was left $25,000 by the will of the late William T. Koch.

Professor Terrien and associates will give their annual course in ocular surgery beginning October twentieth, at the Hôtel-Dieu, Paris, France.

Personals

Dr. Henry N. Blum announces the removal of his offices to the American Bank Building, New Orleans.

Dr. Joseph I. Pascal, who has had temporary offices in Boston, is now located in his permanent offices, 500 West End Avenue, New York City.

A postcard from Dr. Edward C. Ellett of Memphis has been received from Lucerne, Switzerland. He says, "There are lots of people over here."

At the annual meeting of the Michigan State Medical Society at Grand Rapids in September, Drs. Edward H. Cary, Dallas, Texas, and William L. Benedict, Rochester, Minn., were guest speakers.

Drs. Harry S. Gradle, Austin A. Hayden, Leroy Thompson, and Sidney Walker, Jr., have been appointed consultants in eye surgery in the new medical department of the Illinois Industrial Commission.

Dr. Peter C. Kronfeld has resigned as associate professor of ophthalmology, University of Chicago, to accept a position as head of the department of ophthalmology at Peiping Union Medical College, Peiping, China.

Dr. James W. Smith, assistant professor of ophthalmology, Columbia University, New York Post Graduate Medical School, has been appointed a member of the Board of Managers of the Rockland State Hospital, Orangeburg, New York.

Dr. M. Uribe Troncoso has returned from a trip abroad where he attended the International Congress of Ophthalmology as a delegate of the Ophthalmic Institute of the Columbia-Presbyterian Medical Center. He also attended as a guest the Oxford Ophthalmological Congress and read a paper on "Gonioscopic findings after trephine operations."